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The Magazine of Flight Operations • APRIL 1955

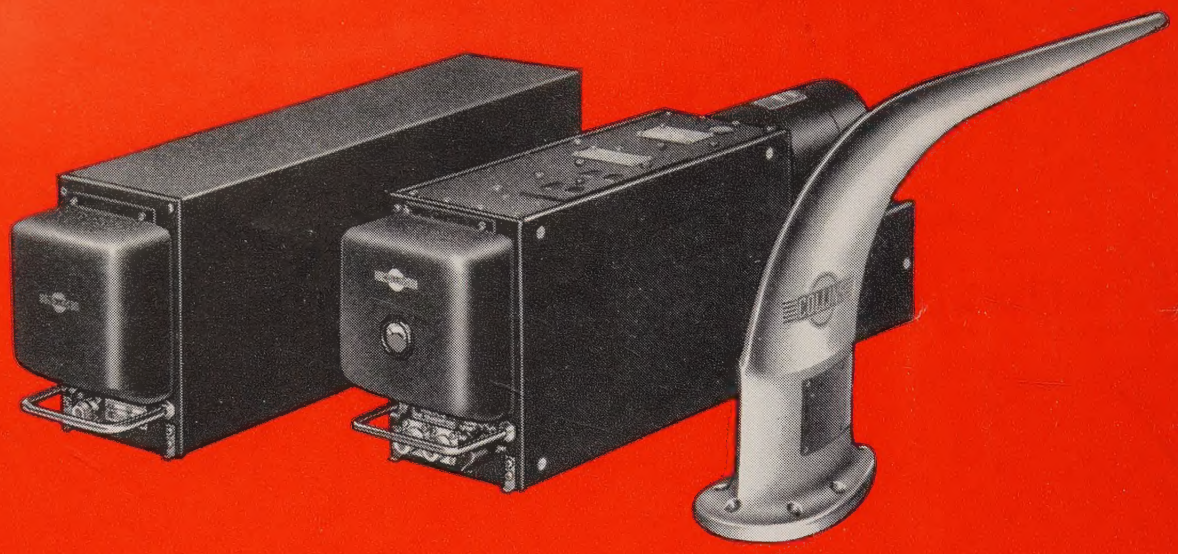
Vickers Viscount

•

Cruise Control: D18S

•

Flight Operations Round Table:
Part II—Problems in Approach Lighting



Receiver 51X-1 Transmitter 17L-4 Antenna 37R-1

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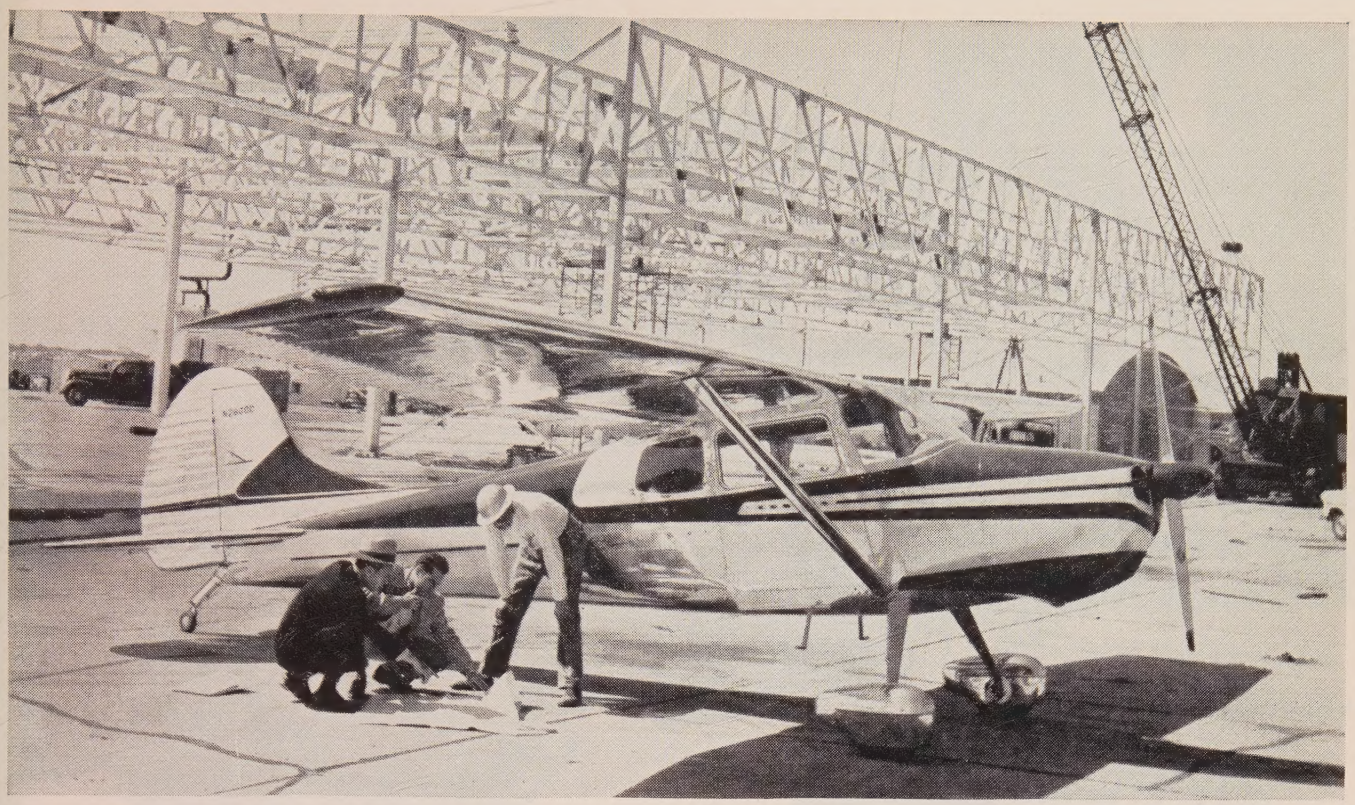

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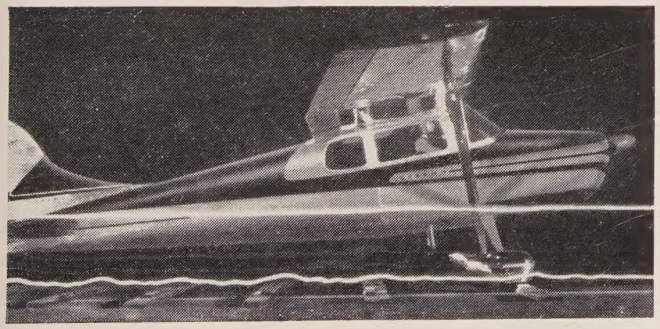

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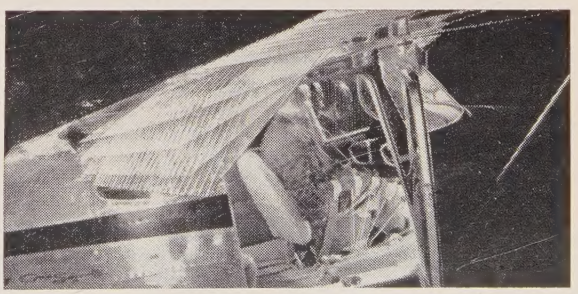

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Chief Pilot Reeves, shown here with a Twin Beech.

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APRIL, 1955

Skyways

The Magazine of Flight Operations

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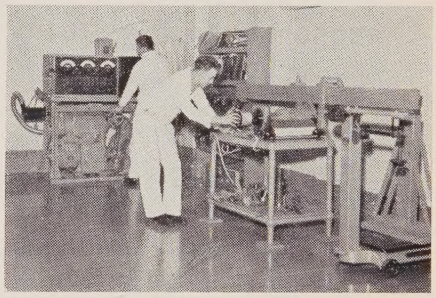

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industry notes . . .

■ North American Aviation has announced the development of a new surface-to-surface guided missile, the long-range SM-64 *Navaho*, for the Air Force. Details of the missile and its performance have not been revealed, but we do know that work on this project has been underway for some time at North American's Downey, California, plant.

■ General Motors recently reported it was spending $75,000,000 of its own funds on facilities and development work at the Allison Division in Indianapolis. The new Allison program includes provision for additional engineering, research and testing facilities to assist in the development of new turboprop and turbojet engines for military and commercial aircraft.

■ British Overseas Airways' order for 20 de Havilland *Comets* is for the Mark IV, a new type incorporating structural design improvements resulting from research investigations at Farnborough and the findings of the Court of Inquiry following the loss of the two *Comet I's* on BOAC's Rome to London run. Powerplants will be RA. 29 Rolls-Royce jet engines offering a 500-lb increase in take-off thrust and a 9% improvement in specific consumption. The Mark IV *Comet* will carry 58 first-class passengers, will have a range considerably greater than earlier models and an increased structural strength.

■ Production models of the Chance Vought F7U-3 *Cutlass* are being delivered to the Navy equipped with Simmonds Explosion and Fire Suppression systems. This new device for protecting aircraft against explosions and fires caused by fuel air mixtures recently completed an intensive program of laboratory and flight tests. It provides protection under all conditions—while the aircraft is parked on the ground, during take-off, at all altitudes and during all flight maneuvers. The F7U-3 is the world's first production aircraft to fly with this passive defense system, developed and manufactured in this country by Simmonds Aerocessories, Inc., under license from the English inventors.

■ Fairchild Aircraft has presented a proposal to the U.S. Navy for a carrier air-resupply version of the basic C-123B assault transport currently being produced for the USAF. Operating on and off a carrier, the airplane would augment the air-resupply of critical priority cargo and personnel, a task now being accomplished in part by squadrons of the Naval Fleet Logistic Air Wings with their present cargo-personnel aircraft. According to Fairchild, the "Flying Lighter" version of the C-123B could deliver aboard a carrier as much as 8 tons of cargo from a distance of 1200 nautical miles, or 4 tons of cargo from a distance of 2100 nautical miles.

■ The British Bristol *Olympus* 101 turbojet engine has been officially approved for service at 11,000 lbs thrust without afterburning. The engine currently is being built in quantity for the Royal Air Force's Avro *Vulcan* bombers. Officials state that the Bristol *Olympus* gives greater power at higher altitude than any other jet engine.

■ Trans World Airlines recently began taking delivery of its fleet of 20 Lockheed Super-G *Constellations.* This latest model of the *Super Constellation* offers greater speed and range than earlier models. Delivery of the 20 G's, which is expected to be completed by mid-summer, will bring TWA's fleet to over 100 *Constellations.*

■ Expanding operations of U.S. airlines in foreign countries and importation of foreign-built aircraft, such as the *Viscount*, have led to the creation of a new CAA post in Paris, France. Raymond B. Maloy, former chief of the CAA Flight Test Branch, has been appointed Aircraft Engineering Advisor in the CAA International Region. Mr. Maloy will provide engineering advice and counsel to U.S. Government agencies, U.S. manufacturers, and U.S. air carriers in foreign countries, and he also will advise foreign governments and manufacturers concerning U.S. engineering standards.

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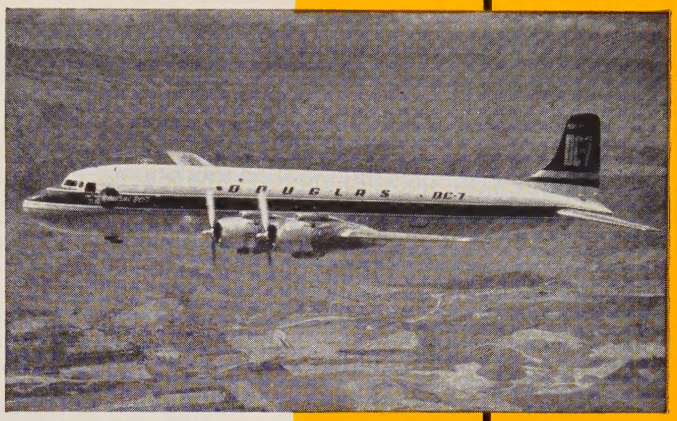
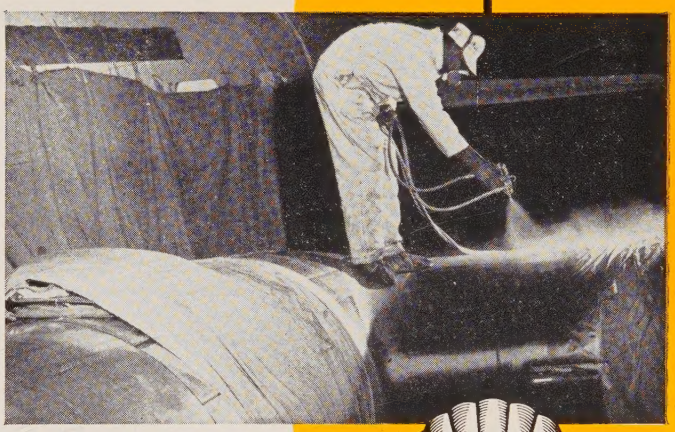
New paint prevents damage by hydraulic fluid, exhaust deposits, weathering on Douglas planes



Above right

Douglas DC-7, new record-breaking luxury airliner.



Applying Epon resin-based "Cat-A-Lac" to exterior wing section of a Douglas DC-7. Cat-A-Lac is manufactured by Finch Paint and Chemical Co., Torrance, California.

FIRE-RESISTANT hydraulic fluid, widely adopted by the airlines, attacks ordinary paint. Faced with this problem, materials experts of Douglas Aircraft Company began a search for a protective coating that would stand up to synthetic hydraulic fluid, as well as wind and rain, erosion at air speeds of 300-400 mph, and corrosive exhaust deposits.

In several years of investigation, more than 300 formulations were tested. *But only "Cat-A-Lac" formulated from Epon resins,* applied in exhaust path areas, was *100% intact after more than 1000 hours in actual airline service.*

Because of the unusual durability of Epon resin-based coatings, they have been adopted by Douglas and leading airline operators for plane areas exposed to hot exhaust gases, gasoline, hydraulic fluid and cleaning solvents.

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If you want a paint that lasts longer, one that has excellent adhesion, resistance to abrasion and impact, ability to withstand extremes of heat, humidity and corrosive atmospheres . . . ask for *Epon resin coatings.* Call on our sales offices for names of suppliers. Write for the full Epon coatings story in the new brochure, "Planning to Paint a Pyramid?"

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PERSONNEL

Dr. Randolph Lovelace II, Frederick F. Robinson, R. Dixon Speas and **Harry A. Bruno** have been elected to the board of governors of Flight Safety Foundation, Inc.

Francis P. Torino recently was elected president of the Air Carrier Flight Engineers Association.

W. F. Munnikhuysen has been elected chairman of the board, and **Fred C. Foy** was named president and chief executive officer of Koppers Company, Inc.

F. J. Mullins has been elected vice president and general manager of American Airlines de Mexico, S.A.

Lloyd R. Earl was elected a member of the board of Pacific Airmotive Corporation. Mr. Earl is president of United Concrete Pipe Corp. **Parke W. Moewe** was appointed general counsel for PAC.

H. Max Healey has been named resident vice president (for the United States) of Avianca, Colombian National Airways. His headquarters are in New York City.

Walter H. Dickman has been appointed vice president of Harley Patents, Inc. He will be in charge of Sales and Engineering.

Dr. Hyman Chessin was appointed assistant director of research and development for the Van de Horst Corporation.

Dunstan Graham has been named department head of Flight Control Systems of the Grand Rapids Division of Lear, Inc.

Joseph Dunn has been appointed project coordinator for the sales engineering section of the contracts department of Bell Aircraft Corp., Texas Division.

Dr. Frederic de Hoffmann has joined General Dynamics Corporation to guide investigations of new applications of nuclear energy. Dr. de Hoffman will be located at Convair Division, San Diego.

Harry A. Rice has been named general manager of Canadian Marconi Company's new facilities at Mount Royal, Quebec. **C. P. McNamara** has been appointed manager of Commercial Products Division, Marconi.

Harry J. Hemler recently was appointed superintendent, Airplane Division, of Grand Central Aircraft Co. He will be in charge of maintenance, overhaul, conversion and modification of commercial and military aircraft.

Arthur H. Jackson has been promoted to the position of project engineer at Hamilton Standard, division of United Aircraft Corp. He will be in charge of blade development program.

A. M. Davis has joined the powerplant division of Marquardt Aircraft Co. He will serve as chief of engineering and manufacturing services.

Joseph K. Decker has been appointed director of purchases for AC Spark Plug Division of General Motors.

James MacDonald recently was named to the public relations staff of The Garrett Corporation.

Major General Fred S. Borum (USAF, Ret), John B. Alison and **John S. Graham** were elected to board of directors of Slick Airways. **Gordon M. Bain** was elected executive vice president.

Henry P. Stanley has been appointed director of aviation sales at AC Spark Plug Division of General Motors.

Jack W. Gailey was named general manager of Dallas Avionics.

COMPANIES

North American Airlines have ordered three more DC-6B's from Douglas Aircraft. North American now has two -6's in operation on its coast-to-coast run and plans to ultimately convert its entire fleet to DC-6B's. The three new ones on order bring North American's fleet to 12 aircraft.

Bell Aircraft has established a new helicopter sales office in Atlanta, Ga. **William K. Allen** has been named Bell representative for the 11 southeastern states, with headquarters at the Atlanta Airport.

Globe Industries, Inc., announced the establishment of the Commercial Aircraft Products Department. **Sidney M. Gamsu** is sales manager of the newly formed department which specializes in the marketing aircraft instruments and accessories.

Dallas Avionics has been elected to membership in the Radio Technical Commission for Aeronautics.

AERO CALENDAR

Apr. 5-7—RTCA Spring Assembly (with Institute of Radio Engineers), Los Angeles.

Apr. 16-20—American Association of Airport Executives annual meeting, El Conquisator Hotel, Tucson, Arizona.

Apr. 18-21—SAE Golden Anniversary Meeting (Aeronautics), product forum and engineering display, Hotels Statler and McAlpin, New York City.

Apr. 18-22—ASME 75th Anniversary meeting, Baltimore.

Apr. 20-22—American Rocket Society spring meeting, Baltimore.

Apr. 24-28—Airport Operators Council annual meeting, Hotel Olympic, Seattle.

Apr. 27-30—American Helicopter Society annual forum, Mayflower Hotel, Washington, D. C.

Apr. 29—Institute of Navigation, Eastern regional meeting, Friendship International Airport, Baltimore.

May 4-6—Fourth Annual International Aviation Trade Show, 69th Regiment Armory, New York City.

May 9-11—Institute of Radio Engineers, aeronautical electronics, Biltmore Hotel, Dayton, Ohio.

June 6-10—Human Engineering Institute, Dunlap and Associates, Stamford, Conn.

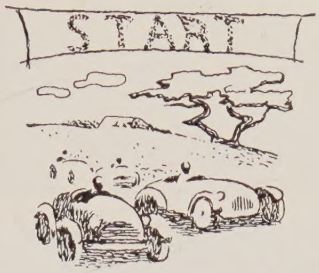
June 12-17—SAE Summer meeting, Atlantic City, N. J.

June 11-12—7th Annual New England Air Tour, Bar Harbor Airport, Bar Harbor, Maine.

June 21-24—Joint Meeting IAS and RAS, (Great Britain), IAS Bldg., Los Angeles.

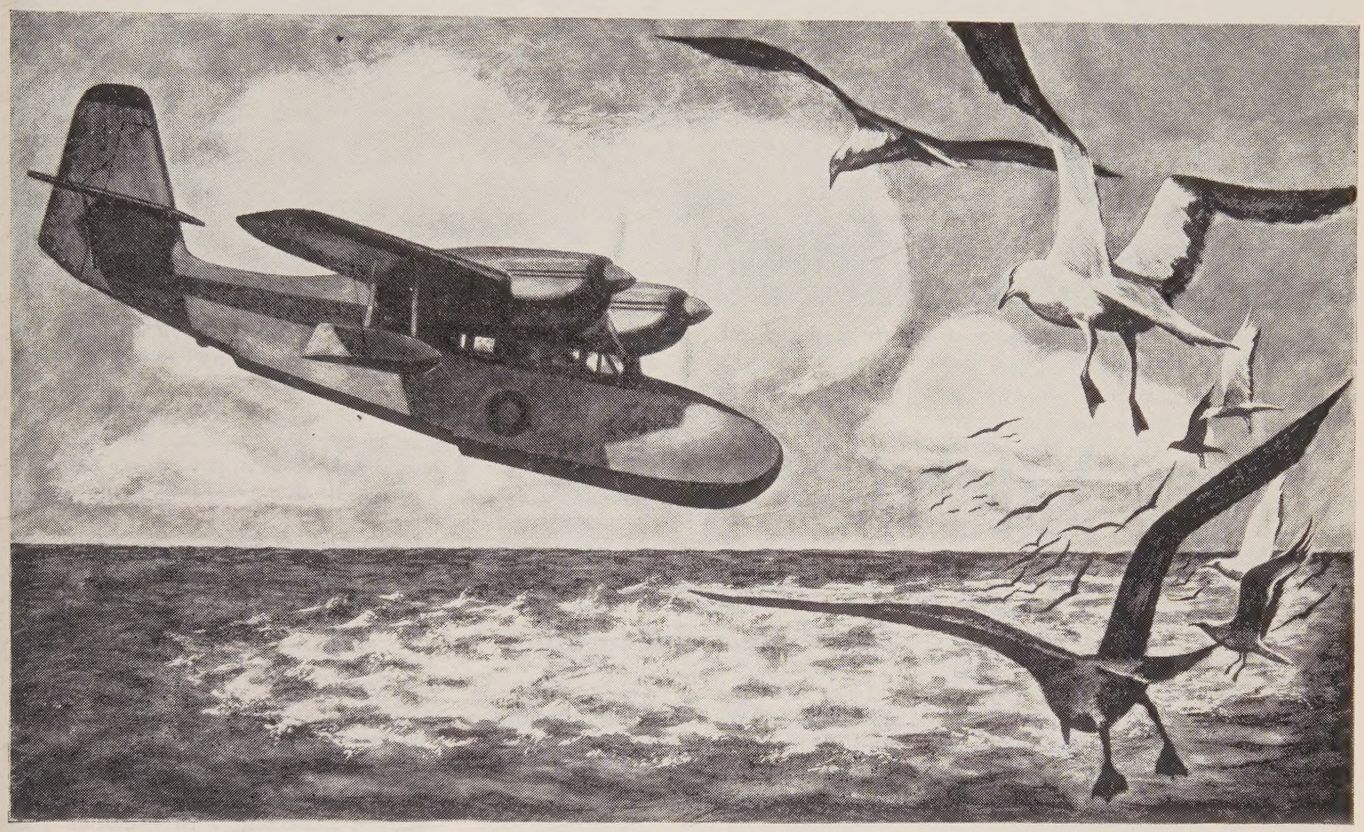
June 21-24—Aviation Distributors and Manufacturers Assn. mid-year meeting, Breezy Point Lodge, Brainerd, Minn.

PLANE FAX



Your Best Week-end Flight Plan for April

Fly to Monterey, Calif., for the annual Pebble Beach Road Races, April 16 and 17. Plan to land at Monterey Peninsula Airport for quality Standard Aviation products and service.



The flying eyes of the tuna fleet

Scouting for tuna! That's W. H. "Hank" Coffin's job every spring, when the tuna start up the Mexican coast. From Whiteman Airpark, Pacoima, California, he flies to Ensenada, where he takes off at dawn to search for the seagulls that fly above the huge schools. He lets down from 5000 to 50 feet to make sure the fish are tuna, then radios his position to the waiting "clipper" boats.

"It's fun to fly low over a sea that's churning with tuna, just as long as I can depend on my plane and its engines," says Mr. Coffin. "I always use RPM Aviation Oil to keep my engines in top running condition—it gives me more safe flying hours. It stops pre-ignition and rough running that's sometimes caused by ordinary compounded oils, and it keeps engines clean of carbon and sludge. With 'RPM', I've been getting 200 extra hours between overhauls.

"I make my ocean flying safer, too, by using Chevron Aviation Gasoline 80/87. It gives me plenty of extra power when I need it, and it's ended the trouble I had with fouled spark plugs when I used gasolines with higher lead content. It leans down for economy, too, at cruising speed."

T. M'S "RPM," "CHEVRON," "PLANE FAX," REG. U.S. PAT. OFF.

TIP OF THE MONTH

It's always a good idea to check your tires before take-off. If one tire is softer than the other, it can cause a ground-loop when you land.

CHEVRON AVIATION GASOLINE
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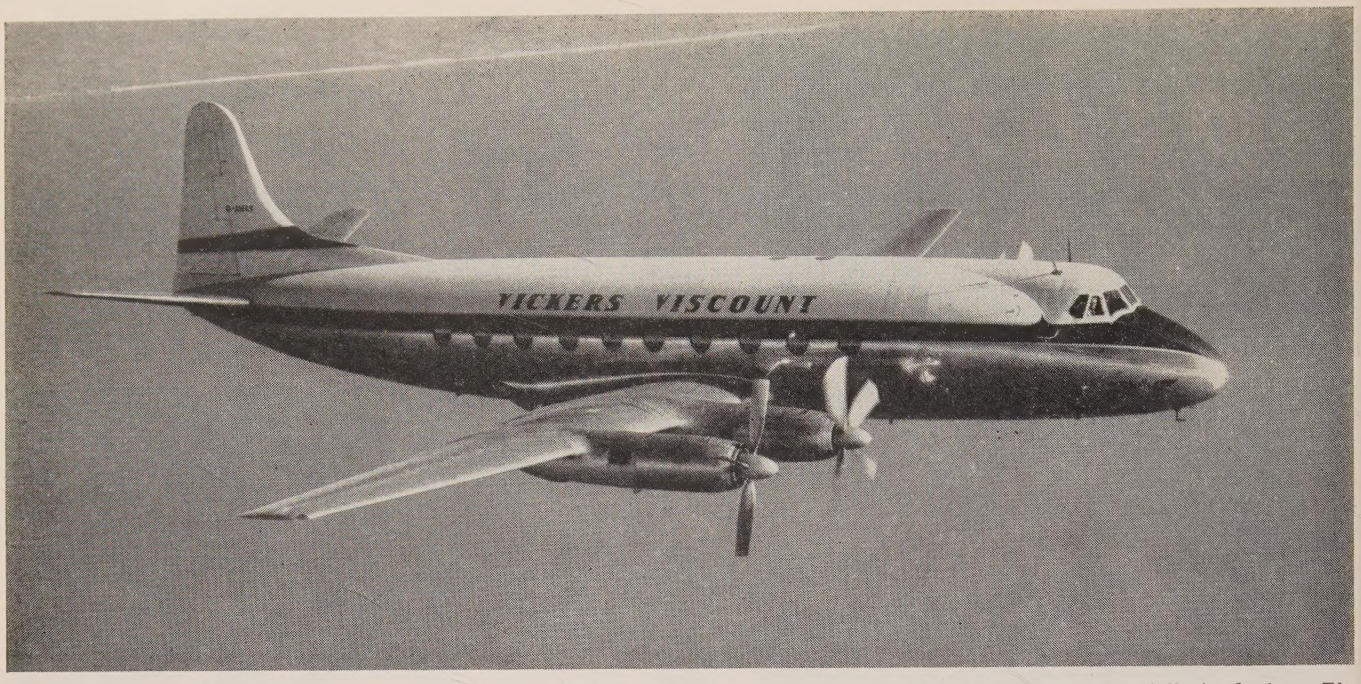


ROTOL *props on the Viscount were especially designed for the Rolls-Royce Dart engine. Pitch ranges from 4° for starting to 21° for flight through 88° for full feathering. The props are just 10 ft in diameter. Note feathered prop above*

VICKERS VISCOUNT

Americanized Version

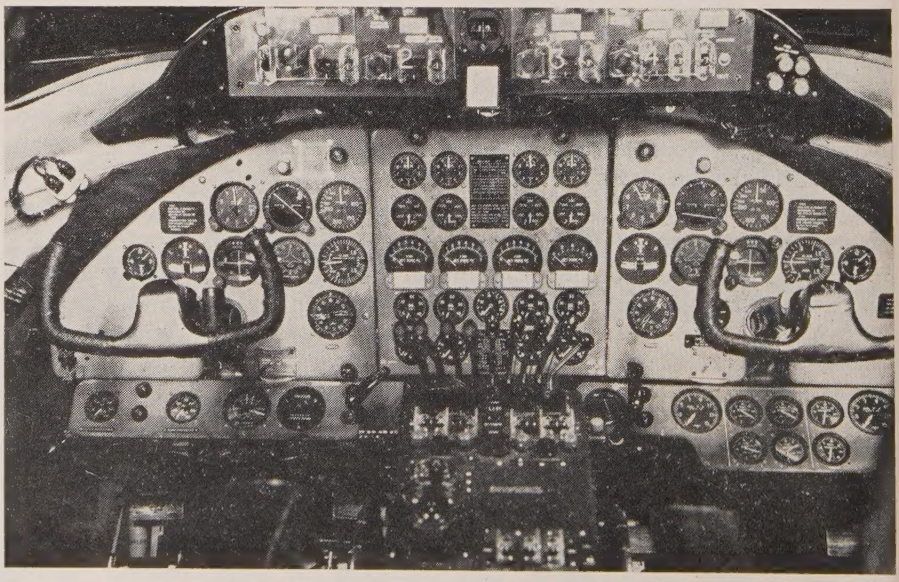
by George McLaughlin

When Trans-Canada Air Lines placed an order for 22 Vickers-Armstrongs *Viscounts,* TCA requested some 250 changes and modifications in the airplane, most of which were dictated by differences in operations, weather, etc., on the North American continent. Similarly, when Capital Airlines placed its order for 60 *Viscounts,* it also suggested modifications, and these as well as the ones being made for TCA are being incorporated in the *Viscounts* which will be delivered to Capital within the next few weeks.

The need for some of the modifications showed up early in 1953 when a prototype *Viscount* was flown from England to Canada for two months of test flying under the prevailing winter conditions.

Practically the entire cockpit layout was redesigned and much additional automatic equipment was installed to reduce the work of the pilots, either of whom can operate the aircraft alone, should such a necessity arise. Standard American instruments were incorporated, except for those directly associated with the engines, and other North American types of equipment, *i.e.* navigation and landing lights, air conditioning, and electrical supply, were installed because of the servicing facilities on this side of the Atlantic.

Although all other navigation and radio equipment on the *Viscount* is American-made (Collins and Bendix), Capital has retained the English-built Marconi radio compass, since the airplane was designed with flush-mounted ADF antennas and the system has proved satisfactory to previous *Viscount* users. Dual controls are standard, and each pilot has an adjustable



VISCOUNT *cockpit layout was designed to meet airline specs. Center panel houses turbo-prop engine gauges; flight gauges are on outer panels; prop switches on across-top panel*

seat with tip-up arm rests. The rudder pedals also are adjustable.

A system for using Esso low-viscosity synthetic lubricating oil was designed by Rolls-Royce, makers of the *Viscount's* powerplants, and TCA was first to order the high-energy ignition which also will be used by Capital. These changes permit the RDA-3 *Dart* engines (or the RDA-6 *Darts*) to be started in temperatures 30° below zero, even after standing idle for 12 hours. The fuel system (with a capacity of approximately 2,342 U.S. gallons) was altered to provide an independent supply for each of the four engines, while at the same time permitting inter-engine connection and cross-feed of the fuel. Although the USAF employs JP-4 in its turbine engines, TCA will be the first of the airlines to use it. Capital is planning to use kerosene. TCA recently contracted with Socony-Vacuum for JP-4, and Capital contracted with Shell Oil for kerosene.

Other "firsts" are the use of a flush-type NACA air inlet which replaces the external air scoop on the belly of the aircraft, and a completely integrated water system which uses superchlorinated water and carbon filters.

Supplementary soundproofing material was installed to make the airplane even quieter than those operating so successfully in Europe. Cabin windows, 26 by 19 inches and largest of any airliner's, are doubled to prevent fogging or misting. A Janitrol combustion heater with automatic controls was installed which will maintain (for Northern operations) a 65°F temperature in both the cabin and the cockpit when the outside temperature is –50°F at an altitude above 20,000 ft. In addition there is an air-cycle refrigerator to prevent either cabin or cockpit temperatures from going beyond 80°F in subtropical operations.

Both the TCA and Capital Airlines version of the *Viscount* have a permissible take-off weight of 60,000 lbs, with a 54,000-lb landing weight and a zero fuel weight of 49,000 lbs. The four Rolls-Royce RDA-3 *Dart* turboprop engines that will power the first few TCA and Capital *Viscounts* have a take-off rating of 1450 shp with an additional thrust of 365 lbs from the tailpipe. Later delivered aircraft will carry RDA-6 *Darts* having a 1550-shp rating. Both of these engines develop well over 1880 hp and offer a cruising speed of over 320 mph. The *Dart* is in the early stages of its career and in the relatively short time it has been available its period between overhauls has been increased from 400 to 1,050 hours, and is expected to be 1200 hours before the year is out.

The only oil approved for use in the *Dart* engine is Esso Turbo Oil 35, a synthetic which is higher in initial cost ($14 a gallon) than standard oils for reciprocating engines but which is consumed in such small quantities that the high first cost is offset. This Esso Turbo 35 is not changed between overhauls and is, therefore, considered to be "a part of the engine." When the British European Airways' *Viscount* was flown from London to Christchurch, New Zealand, a distance of over 12,000 miles, oil consumption was ½ pint per engine for the entire trip!

The four *Dart* turboprop engines are assembled as interchangeable power units. The design of the airframe itself and the use of four-bladed Rotol propellers only 10 ft in diameter permit use of slim nacelles close enough to the ground for most servicing points to be reached without trestles or ladders. The cowling doors are airframe parts, hinged to the structure aft of the firewall. By releasing the toggle fasteners, top and bottom panels are swung up and down respectively, after which the doors are opened wide and clipped to catches on the wing. This leaves the entire powerplant exposed for servicing or removal.

The engine has a two-stage compressor driven by a two-stage turbine which turns the prop through a reduction gear. Diameter of the engine over the cowling is 3 ft 2 in. An annular air intake is located behind the propeller spinner, at the top of which is a separate air intake for the oil cooler. Both intakes are protected from ice during winter operations by electrically heated overshoes. The intake assembly is an integral part of the engine, and the oil tank is cast around the air-intake casing to form part of a self-contained lubrication system. Heat from the oil aids in keeping the air intake free of ice.

The compressor has an air mass flow of about 20 lbs. per second and a pressure ratio of 5.5 to 1. Air is delivered into seven interconnected combustion chambers, two of which have high-energy igniter plugs for engine starting. The fuel is sprayed downstream from the burners inside the flame tubes.

The two turbine wheels are attached to a single shaft which forms the direct drive from the compressor and is continued to the first train of the reduction gear. The drive from the compressor shaft to the propeller is transmitted through a compound gear train providing two stages of speed reduction. The over-all reduction gear ratio is 0.106 to 1. A bevel gear engaging the main shaft provides the starter drive, and further bevel gears drive the fuel and oil pumps and the constant speed unit. A train of spur gears behind the compressor provides the accessory drive which is lead rearward by a shaft from a universal coupling atop the engine casing.

Under high-temperature or tropical conditions, automatic water/methanol injection is used as a power restorer instead of as a power boost as with piston engines. Whe the system is switched on and the throttle levers are full forward, the water/methanol is metered to the engines in sufficient quantity to restore full power but not overload the engines. When power is reduced to the maxi-

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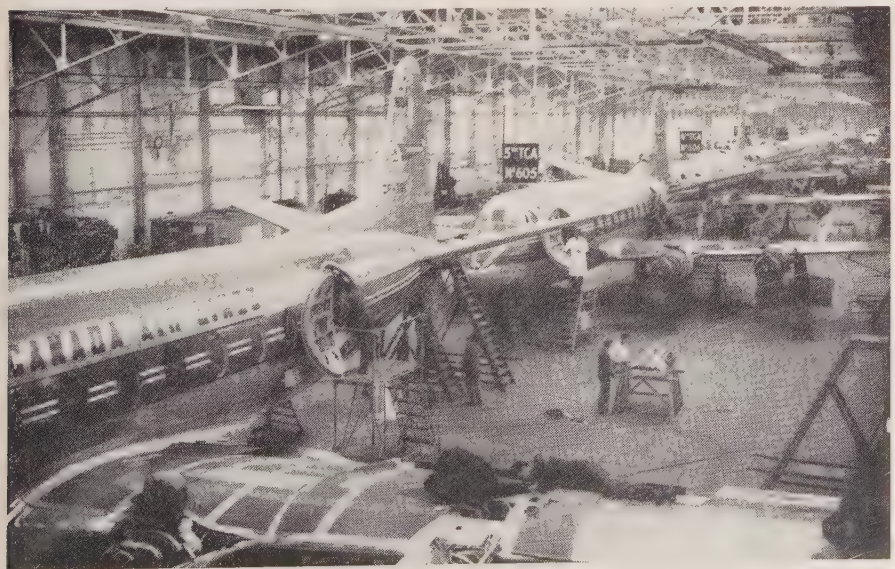
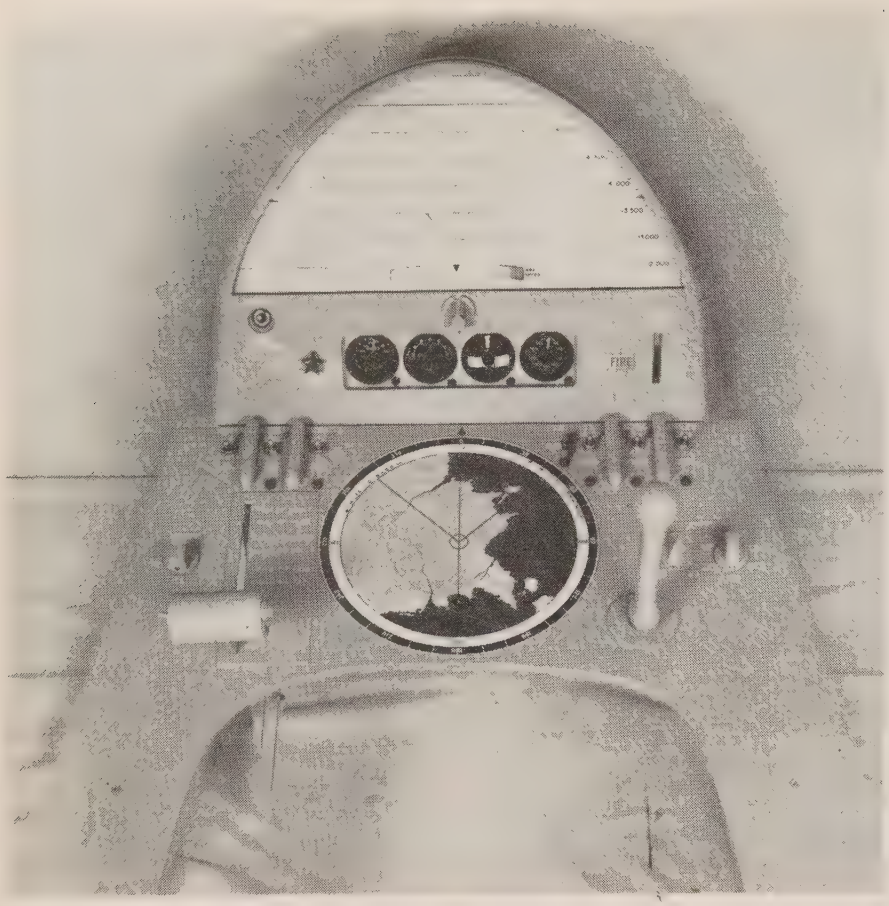


VICKERS-ARMSTRONGS *production plans call for 55 Viscounts in 1955, with number to increase in '56 to 70 or more. To date, various airlines have placed orders for 178 Viscounts*



INSTRUMENT *panel for tomorrow's military jet aircraft gives the pilot necessary information in simplified manner, thus enabling pilot to perform at peak efficiency*

A New Concept for Airline Cockpits

by LCDR George W. Hoover, USN

Office of Naval Research

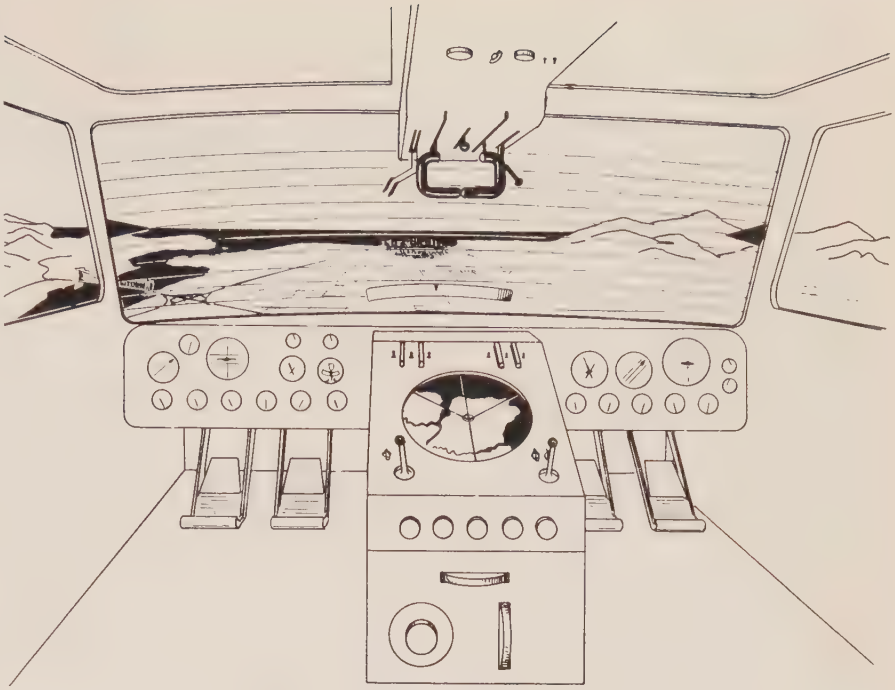
Every non-pilot who has taken a good look at the cockpit of a modern airliner has invariably made the remark that it is amazing how pilots are able to keep track of the maze of instruments and controls that confront them. Frankly there are a great many pilots who are just as amazed, although few will admit it. Perhaps this unwillingness to admit that the cockpit is too complicated for efficient operation is one of the paramount reasons why pilots have to put up with such complexity. As a rule pilots are inherently adverse to radical changes in cockpit configuration. Such reluctance probably is due to the fear of having to depend on less reliable equipment or of having to change habit pattern. The very fact that they are hesitant to change, however, indicates that they recognize the seriousness of their business and rebel against changes which might cause them to make a fatal error.

There has been just *one* change in cockpits over the last 20 years: acceptable or not, they have become more complicated. This is undoubtedly due to a compromise on the part of the pilots to accept new equipment providing standby equipment is also available. The complexity of the cockpit is also a result of the increased performance of the aircraft and the necessity to operate it for longer periods of time as well as during adverse weather conditions. Many things have been added to cockpits, but very few things have ever been removed. The pilots' acceptance of additional equipment is understandable because when things begin to happen fast in an airplane a pilot wants everything he can get which may be of assistance in getting his airplane back on the ground in one piece. Herein may be one of the best indications that the present cockpits do not provide the pilot with adequate information to solve his problems without a terrific amount of mental gymnastics.

If we are to make really significant progress toward development of a cockpit capable of being operated at any time in an errorless and efficient manner, we should establish a *dual program*. In one program we must continue an everyday effort aimed at meeting the immediate cockpit requirements by whatever means is available. Even sacrificing payload should be considered in order to provide the pilot with a completely adequate system of controls and instruments. This program can only accept the best compromise in order to provide equipment as quickly as possible. In addition to this program, however, a long-range program should be established in which all research and development would be aimed at a definite goal, *i.e.* a cockpit system which would permit operation at any time regardless of weather (tornadoes, typhoons, etc., excluded), with a minimum of weight for the equipment, a maximum of reliability, and requiring a minimum amount of training. This long-range effort should be carried on with completely uninhibited thinking, accepting no compromise, and constantly seeking absolute answers instead of interim solutions. Actually, as interim solutions became apparent, they would be fed back to the everyday program for implementation. Such a dual program would permit equipment-design based upon known scientific facts rather than pilot or engineering opinion.

Any long-range program, because of its concept, will only approach its ultimate goal asymptotically; it must however, have a definite starting point. In a research and development program the starting point must be a complete statement of the problem in its most fundamental terms. Since the cockpit is to be used by pilots, the pilots are the only ones who can thoroughly state the problem by establishing *their* requirements.

One of the main reasons for not having adequate information in the cockpit is that pilots have never clearly stated *what it was that they wanted*. When asked what informa-



AIRLINE *adaptation of the projected instrument panel for military aircraft will permit truly all-weather operation with minimum of equipment, maximum of reliability*

tion he wants, the average pilot will almost invariably state his requirements in terms of instruments and equipment which he has flown before, rather than call for anything new. If pilots want an answer to the problem of instrument flight, they must state the problem in fundamental terms rather than let engineers state it for them in engineering terms.

For example, let's look at the first phase of any flight, the take-off. Let's assume that this is an instrument flight, in order to determine exactly what information must be provided in lieu of visual conditions.

We will discuss only two of the requirements in this phase of flight. The first bit of information required is the alignment with the runway. Here the pilot is concerned with his position with respect to the center line—not heading as given by a directional gyro or compass. Heading alone will not tell him where the edge of the runway is as he starts his take-off run. In contact weather this information is apparent and easy to use, so in some way we must find a method of reproducing an analogue of this data for instrument-flight conditions. Thus we now have our first basic requirement—lateral position on the runway. No pilot can truthfully state that this is not necessary information. It is true that we make instrument take-offs without it, but it requires a great deal of concentration and continued practice.

The second requirement is position with respect to the length of the runway. In other words, the question asked by the pilot is, can we get airborne before we get too far down the runway? This becomes very critical when operating from fields with short runways, in aircraft with high load and low lift characteristics. This requirement may not be a necessity at all times, but would relieve the tension of the pilot, and it is still a basic piece of information.

For too long a time pilots have accepted compromises rather than demanded what they really wanted in the cockpit. If simpler cockpits are ever to become a reality, they will not be designed by engineers or pilots but rather by a team of engineers and pilots working with psychologists, medical doctors, and physicists.

It is rather evident that present-day cockpits have been designed primarily by engineers because the controls and instruments are presented to the pilot as factors of an equation rather than answers to very important questions. Engineers think in terms of equations so it figures that the equipment which they design will be in the same terms. This is not meant to deride the engineers but rather to point out that the aircraft manufacturer may be hiring the wrong man to do the job. You don't ridicule a blind man when he stumbles, but neither do you hire him to do a job where stumbling might be critical.

All that any pilot wants from his instruments is an answer, not factors. At the present time if a pilot wants to know where he is geographically, or even in terms of distance from his destination or point of departure, he must derive his answer from the bits and pieces of information with which he is provided. First, he must read his airspeed which because of instrument design is not true but indicated. Then he checks the outside temperature in order to correct his altimeter so that he can correct his airspeed for altitude in order to determine true airspeed. This tells him very little because airspeed must be tied in with wind direction and velocity in order

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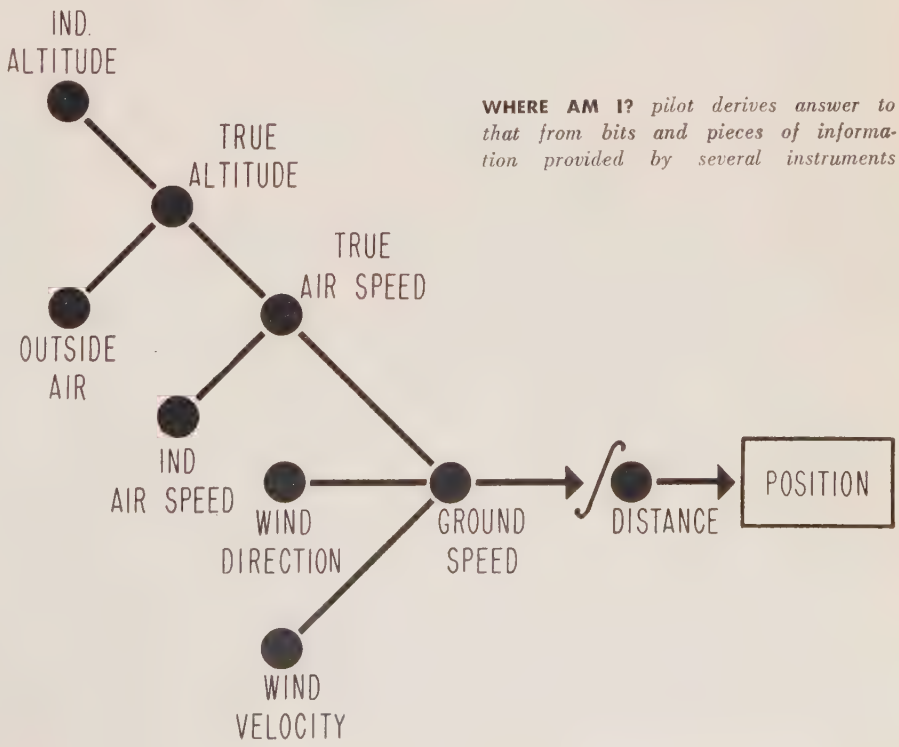


WHERE AM I? *pilot derives answer to that from bits and pieces of information provided by several instruments*

by Robert K. Polson

Executive Pilot

CRUISE CONTROL - D18S

Discussions with various pilots who fly the well-established Beech D18S indicate that most of them could use more cruise-control information than they currently possess. The difficulty seems to be that it is not obtainable from any *single* source. In some cases, information originally delivered with the aircraft has been lost, leaving the pilot with little more than a green line on the manifold pressure gauge. In the last few years the author has been striving to assemble more accurate information on this subject. The results of that investigation are offered to the business pilot in the hope that they will be of some assistance.

This is not intended to be a treatise on long-range flight; neither has basic cruise control been reviewed, except to bring out more recent thinking or to show where a search has been made in the calculations for answers applicable specifically to the D18S. Inasmuch as the graphs and calculations were originally made for my own use, the views expressed herein are those of a pilot, and some theoretical considerations, true from an engineering standpoint, have been modified to better fit the requirements of the business pilot.

Available Fuel: Numerous trials of metering fuel into empty tanks have indicated that the attitude of the aircraft in fueling position, whether due to shock-strut inflation or terrain, has a decided effect on the amount of fuel which can be taken aboard the wing tanks. Although the placarded 286 gallons is all usable (and can in fact be loaded if the aircraft is ideally situated), the tests disclosed the sensitivity of position to be such that, for average conditions, an approximate allowance of one gallon per each wing tank should be made for this effect. The nose tank did not appear effected by the fueling position.

Further fueling tests were made to establish the amount of fuel consumed in starting, taxiing, warm-up, and take-off. This was done by switching from the originally full take-off tank, at the point of reduction to climb power, in order to enable measurement. Metering fuel into this tank after landing, and doubling the result gave an average (over several tests conducted at 50°F) of 5 gallons which should be allowed for this purpose.

An additional ½ gallon per thousand feet of cruising altitude should be allowed for "climb fuel" occasioned by the higher climb power and enriched mixture. This allowance does not consider the additional fuel occasioned by slow climbing airspeed. However, correction may be made for this factor by either doubling the altitude and adding the result (as miles) to the mileage to the first check point, or dividing the cruise altitude by two and adding the result (as minutes) to the time to the first check point. A number of pilots also add an additional 6 minutes to the point-to-point time to allow for maneuvering after take-off and for traffic pattern at the destination.

The thought is often advanced that fuel density changes are not important on relatively small aircraft because of the few gallons involved. The relationship of gallons lost, by reason of high fueling temperatures, to the lesser consumption of smaller aircraft indicates that the loss in endurance *time* may be as great on such aircraft as for a multi-engine transport. Although the problem does not warrant exact calculation for every fueling temperature, it would appear good

FIGURE 1

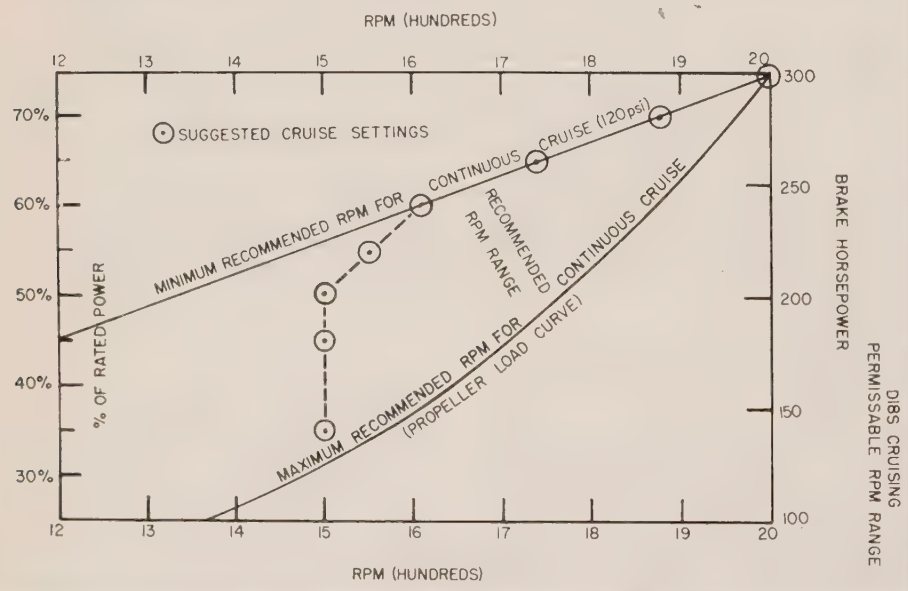
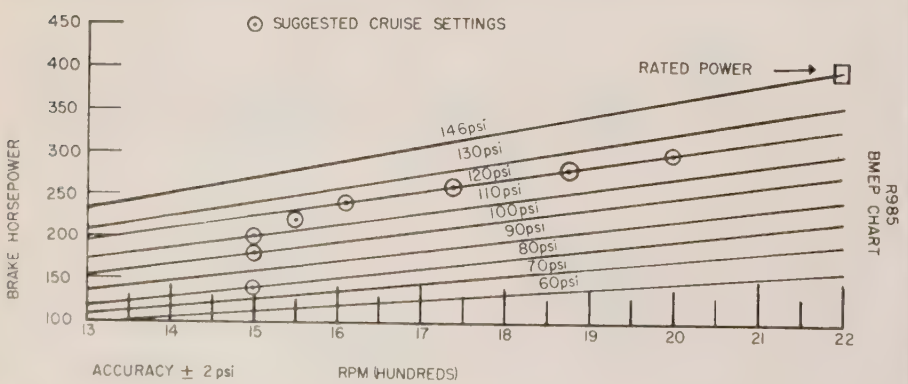


FIGURE 2



practice to deduct 7 gallons from full tankage for summer operation. (This corresponds to the correction factor existing at approximately 90°F.)

The purpose here is to establish within the realm of both accuracy and practicality, the *available fuel* (or effective fuel) to be used for flight-planning purposes. This fuel can be found by summarizing the above factors and deducting the total correction from the fuel load. An example for summertime operation follows:

Unavailable fuel (Due to fueling position)	4 gals.
Warm-up, taxi, & take-off	5 gals.
Climb fuel (to 8,000 feet)	4 gals.
Density correction (For full tankage)	7 gals.
Total correction	20 gallons

Consumption and Endurance: Consumption as calculated from specific fuel consumption data seldom results in an even number of gallons. Odd tenths have been eliminated in the direction of conservatism and because of accuracy limitations in setting power:

BHP	@	RPM	MIXTURE	CONSUMPTION (BOTH ENGINES)
450	@	2300	Rich	101 GPH
400	@	2200	Rich	88 GPH
360	@	2150	Rich	76 GPH
320	@	2100	Rich	65 GPH
300	@	2000	.080	60 GPH
300	@	2000	.076	56 GPH
280	@	1875	.076	49 GPH
260	@	1740	.072	41 GPH
240	@	1610	.072	38 GPH
220	@	1550	.072	35 GPH
200	@	1500	.072	32 GPH
180	@	1500	.072	30 GPH
140	@	1500	.072	26 GPH

These figures are applicable for altitudes in the vicinity of 7,000 feet, and will increase approximately ½ GPH for every 100 RPM increase above the suggested settings. The full range of powers was covered in order that the pilot might have access to single-engine consumption at the higher power settings should they ever be desired.

Twin-engine emergency endurance is 1400 RPM and sufficient throttle to stay aloft, but is not included because it varies with gross weight. Flight tests indicated that this setting would be approximately 30% of rated power. It may also be demonstrated that single-engine endurance at the lower gross weights exceeds endurance on both engines.

A particularly useful setting is 35% power @ 1500 RPM, and is suggested for IFR holdings. Here the considerations are fuel conservation, sufficient airspeed for good control on instruments, and observation of engine temperature and pressure

NOTE: Dashed line area indicates full throttle operation. BMEP in this area of operation will be less than indicated due to maintaining BHP by increased RPM

FIGURE 3

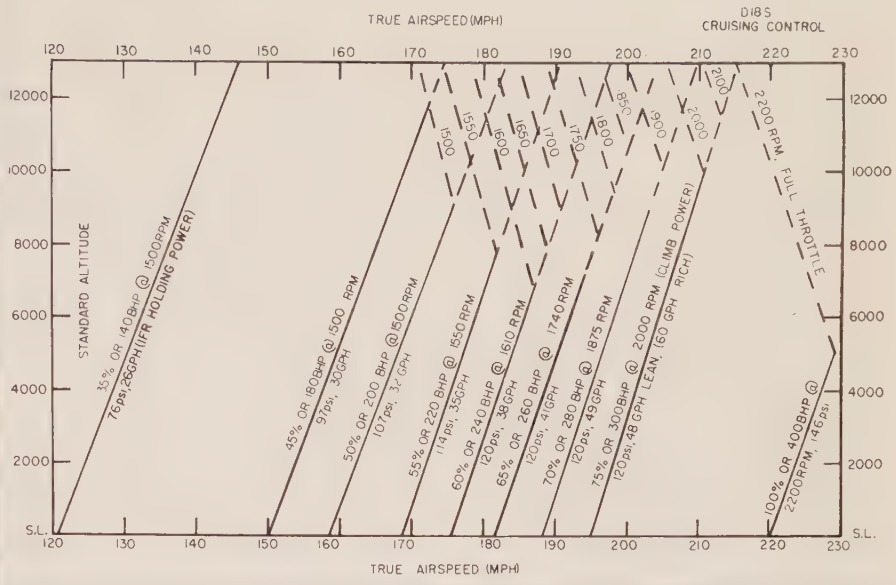
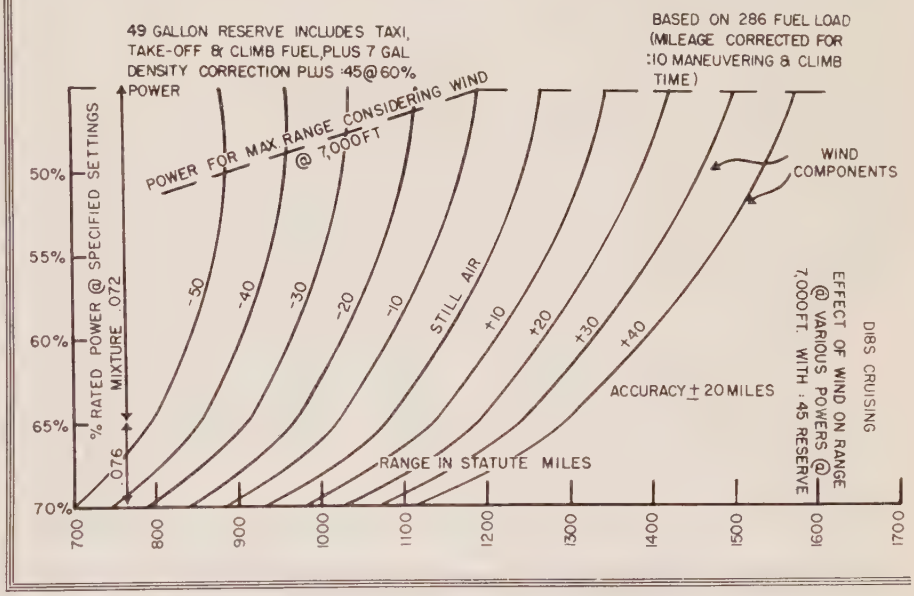

TRUE AIRSPEED (MPH)
DIBS CRUISING CONTROL
STANDARD ALTITUDE
35% OR 140BHP @ 1500RPM 76psi, 2.6GPH IFR HOLDING POWER)
45% OR 180BHP @ 1500 RPM 9.1psi, 3.0GPH
50% OR 200 BHP @ 1500 RPM 10.7psi, 3.7 GPH
55% OR 220 BHP @ 1550 RPM 11.4 psi, 3.5GPH
60% OR 240 BHP @ 1610 RPM 12.0psi, 3.8GPH
65% OR 260 BHP @ 1740 RPM 12.0psi, 4.1GPH
70% OR 280 BHP @ 1875 RPM 12.0psi, 4.9GPH
75% OR 300BHP @ 2000 RPM (CLIMB POWER) 12.0psi, 4.8 GPH LEAN, 16.0 GPH RICH)
100% OR 400BHP @ 2200RPM, 14.6psi.
2200 RPM, FULL THROTTLE
S.L.
TRUE AIRSPEED (MPH)

FIGURE 4


49 GALLON RESERVE INCLUDES TAXI, TAKE-OFF & CLIMB FUEL, PLUS 7 GAL DENSITY CORRECTION PLUS :45@60% POWER
BASED ON 286 FUEL LOAD (MILEAGE CORRECTED FOR :10 MANEUVERING & CLIMB TIME)
POWER FOR MAX RANGE CONSIDERING WIND @ 7,000FT
WIND COMPONENTS
% RATED POWER @ SPECIFIED SETTINGS
MIXTURE .072
.076
-50
-40
-30
-20
-10
STILL AIR
+10
+20
+30
+40
ACCURACY ± 20 MILES
RANGE IN STATUTE MILES
EFFECT OF WIND ON RANGE @ VARIOUS POWERS @ 7,000FT. WITH :45 RESERVE
DIBS CRUISING

limits. This setting appears to meet the requirements admirably, and has the effect of increasing fuel reserves.

Altitude Choice: No one but the pilot himself can resolve the choice of cruising altitude. With most business pilots, passenger comfort is the determining factor rather than aircraft speed. This suggests utilization of the higher altitudes as a solution. Rather than rehash technical generalities as to *why* one should "get upstairs," calculations were made to determine the optimum altitude for minimum flight time over various trip lengths in still air at 60% power. As a concession to practicality, 2 minutes delay was established as a reasonable price to pay to find smooth air on short trips, provided at least 20 minutes in cruise configuration would be available at that higher, more-comfortable altitude. The results established that for any trip of 150 miles or more, the answer became not "why," but "why not?" The calculations disclosed the following:

Trip Length (Statute)	Optimum Alt. for min. flight time	Max. Altitude for at least :20 in cruise	Delay time (Minutes) to cruise @ Max. altitude
100	3,000′	5,000′	:02
150	4500′	10,000′	:02
200	6,000′	10,000′	:01½
250	7500′	10,000′	:01
300	9,000′	10,000′	:00½
325	10,000′	10,000′	:00

Percent of Rated Power: How much power to use for cruise is

largely a question of economics. The entire range of power is available up to the maximum approved by Pratt & Whitney, 75% of rated power. If speed is desired, it can be obtained at a reasonable price. On the other hand, powers somewhat below this give a very acceptable speed and a greater range.

BMEP: The engine speeds listed in Consumption and Endurance (*page 13*) may appear low to those pilots who have not had opportunity for engine-operation review since prewar times. Before proceeding further, statements made by Pratt & Whitney in their publication "*The Aircraft Engine and its Operation*," are quoted as a source of more recent thinking.

"Engine friction is reduced by a decrease in RPM. The decrease in sliding and rolling friction more than offsets the corresponding increase in pressure friction.

"Reciprocating and centrifugal loads are reduced by a decrease in RPM. Cylinder pressure opposes and cushions these loads which predominate in determining the stresses on the master rod bearings."

"Detonation is reduced by a decrease in RPM. Inasmuch as the tendency of a fuel to detonate is determined principally by temperature sensitivity, a low impeller RPM with attendant low temperature rise through the supercharger is favored. The heat rise varies chiefly with the impeller speed and is relatively unaffected by power.

"Fuel consumption is reduced by a decrease in RPM due to less friction horsepower required to deliver the required BHP at the propeller shaft.

"Cylinder cooling is improved by lower RPM. Low engine speed is the most effective way to control the tendency of the oil to overheat.

"Present developments of engine suspension systems are such that, in general, there is little, if any, limitation to the use of the full RPM range, and speeds as low as 1200 RPM may be entirely practical.

"It may be concluded from the foregoing that it is generally preferable to operate the engine on the side of high manifold and cylinder pressures, and low RPM.

"Cylinder pressure must be limited, however, because of structural and experience considerations. These limits can be described in terms of BMEP.

"The following is the recommended lean mixture BMEP limit for the *Wasp Jr.*—120 psi. This limit was determined by extensive engine testing, and adherance to it will result in the greatest benefits of engine durability for the average operator."

Whenever confronted with the word "maximum" used in connection with an operational limit, my previous thinking has been to operate slightly below that figure. However, in this instance such procedure apparently amounts to a gain of nothing but an increased engine wear factor. Mr. A. Lewis MacClain, Pratt & Whitney Installation Liason Engineer, in a letter to the author states that detonation with 80/87 fuel has been the principal determining factor in selecting 120 psi as a maximum, and P&W feels the engine will run there with a satisfactory margin of freedom from detonation. The old "bugaboo" of detonation would seem to be nonexistent as long as we do not exceed 120 psi BMEP. Before proceeding further, however, I would like to mention some additional considerations.

(1) The advantages of full-throttle operation can be achieved safely only *at* or *above* the critical altitude for the RPM at which the desired horsepower is being delivered at 120 psi. Operation at full throttle *below* this altitude results in a BMEP higher than the maximum recommended.

(2) In the range of lower BHP settings, the choice of a very low RPM, in order to maintain 120 psi, results in too low a critical altitude to be of practical value. Where this occurs, power can only be maintained by raising the RPM to a higher value.

(3) Extremely low RPM may result in insufficient operating temperatures and pressures. Carburetor heat is also affected by lower RPM's.

(4) Generator output, where regulated to a higher RPM, will decrease measureably at lower RPM's and cease entirely if engine speed is lowered below generator cut-out speed.

(5) The use of too low an RPM may load the propeller airfoil to a value it cannot efficiently carry.

(6) Airframe vibration difficulties which might prove detrimental to the aircraft may develop at extremely low RPM's.

The settings suggested (*Fig. 1*) represent a search for values closer to maximum theoretical efficiency, yet they are compromised in light of the above considerations. A lower limit of 1500 RPM gives promise of resolving these considerations.

At the settings listed, the author has had no difficulty in maintaining proper engine temperatures and pressures. In all probability, few pilots will ever use 50% power unless they are planning an over-water hop to Panama or a similar destination, in which case generators may be set to a higher output for that particular flight. Generator output while "holding," although lower than at 1800 RPM, is believed ample for the length of time involved.

Information on propeller airfoil characteristics indicates that the problem of overloading becomes a factor between 1200 RPM and 1500 RPM depending on the power applied to the airfoil. This could conceivably occur at even slightly higher RPM where 120 psi is exceeded, which obviously is not in line with recommended operation. This overload may be disclosed as decreased airspeed at very low RPM settings. No difference in performance was noted at the maximum power for which 1500 RPM is suggested as compared to that same power at a higher RPM.

The Structures Engineering Division of the Beech Aircraft Company stated they knew of no airframe vibration problems at the settings quoted. A further check with the powerplant installation engineering section of the CAA revealed that there are no restrictions on the engine-propeller combination which would inhibit operation in the lower RPM ranges. Pratt & Whitney disclosed that vibration studies in the early days of the airplane indicated more vibrational stress in the vicinity of 1900 RPM than at lower revolutions.

However, the question of what is legally permissible is somewhat different than what is to be recommended, based on present information. The difficulty is that present information on operational characteristics of this aircraft at these very low RPM's is limited. Inasmuch as the advantages of RPM's lower than 1500 are slight and would be sought only under the most unusual conditions, the settings suggested are limited to that 1500.

An additional advantage of lower RPM cruising is the noticeably improved cabin sound level. Where the cabin is utilized for business purposes, this is desirable.

The permissible RPM range is shown in *Figure 1*, with suggested settings plotted thereon. Minimum RPM is represented by the line of 120 psi BMEP. Maximum RPM is defined by the propeller load curve, the high RPM restriction for continuous cruise as recommended by the engine manufacturer. A BMEP chart is included as *Figure 2*.

Correlation of Power & Speed: *Figure 3* displays the relationship of power to speed and is from an original chart developed by Beech Aircraft.

The airspeed gain with altitude is denoted by the slope of the lines, and is quite pronounced. The accumulative effect of this performance char-

(*Continued on page 44*)

by Willis L. Nye

Production Engineering in OVERHAUL

Air-transport overhaul, when conducted on a volume basis, presents a real challenge to the production engineer. The problems associated with air-transport overhaul operations or cycled-maintenance programs are somewhat akin to those encountered in transport manufacturing, *i.e.*, the expenditure of man-hours and materials, cost control of man-hours and materials, and the installation of parts after overhaul. These operations require an integration of inspection functions, removal of parts and assemblies, cleaning of the entire airplane, repair of serviceable parts, re-installation of serviceable parts, and complete functional and flight testing. All of these operational functions can be time-consuming and, therefore, costly to the customer. How the cost of overhaul or maintenance operations can be controlled depends upon the effectiveness of production-engineering methods.

Because of the somewhat indeterminate usage to which an air transport has been subjected, a degree of uncertainty exists as to what repairs may actually be necessary. The inspection records aboard the airplane do not always reveal the facts. Therefore, the essence of initial control and expenditure of man-hours is predicated upon a thorough and reliable inspection report before the airplane enters the production system. Precise preliminary inspection permits precise planning in advance and makes it possible to allocate a budget of man-hours to such an extent that the work load can be predicted with certainty. This makes it possible to determine the dollar costs which, after all, are the principal concern of the customer.

Handling Fixtures and Test Equipment: One of the preliminary actions required of the production engineer is to make a survey to determine how the handling fixtures and test equipment will be disposed along the production line. The amount of this equipment that is required is a function of the movement of the airplanes from one station to another and the planned delivery each month. The results of this preliminary estimate, based on the over-all dimensions of the airplanes and how they will be handled and moved, must be translated in terms of procurement of additional equipment based on the anticipated work load. An accurate estimate of the work load will aid and later simplify cost-control systems. In the way of cost, the amount of handling and test equipment largely determines how much man-power must be expended. Thus, the initial survey must consider all factors to be secondary to cost and the proposed program of delivery of the airplane to the customer. For example, whether it will be more expeditious to perform certain operations at one station or spread the work over several stations should be determined. Other factors to consider are the distribution of labor and the availability of the test equipment to check functional operations.

Factors Affecting Cost of Reconditioning: In the initial planning stages, the production engineer has to evaluate such factors as what inspection compliances must be accomplished—the availability of serviceable parts—the available manpower and the over-all level of experience of the personnel—customer modifications—customer inspection requirements and inspection standards—the probable condition of the air transport on arrival at the overhaul facility—and the kind of contract existing between the customer and the over-haul facility. This latter factor is important because it will determine whether the production engineer must allocate a positive budget to accomplish the specified work or whether certain allowable extra expenditures will be permissible to meet airworthiness requirements. Secondary factors such as weather conditions, labor turnover, daily labor availability, and supervision experience must also be considered in setting up the program of delivery. All of these factors may not always be under the control of production engineering and planning but, in general, the production engineer is able to plan for anticipated conditions. This ability to plan is based on a combination of his past experience in similar work, and good judgement.

Work Control: No pre-planned production program can function unless the production engineer makes certain the production-line operations are in compliance with the pre-planned working schedule. The first step in pre-planning is to segregate the work operations of each functional system and set them up in the proper sequence of accomplishment. After this has been done, the second step is to assign the various sequences of work operations to each of the inspection control points or production-line stations. Thus, the overhaul or maintenance operation can be accomplished in a progressive manner.

After the production line and the work operations have been coordinated, the next step is to assemble cost information relative to the expenditure of man-hours and materials for each functional system and production-line station. This information should be assembled at the start of a production program, and from this data the production engineer can begin to formulate action which will keep the man-hour budget within the limitations of the preliminary estimate. This requires an analysis of each plane project in order to determine what corrective action must be taken to keep costs in line.

Although it is a laborious and costly overhead operation, the assimilation of man-hour expenditure data is of major importance to the success of any production program. For example, each operation called for in the production planning order is coded with a cost-accounting number. This makes it possible to determine the distribution of labor among the assigned work operations as entered on the shop time cards. In this respect, the production engineer must work very closely with the timekeepers so that neither misrepresentations nor erroneous entries will be made. Constant training of the timekeepers is part of the production-engineering program of determining the time standards for each phase of the work operations. Frequently, it may be necessary for the production engineer to exercise his (*Continued on page* 36)

SKYWAYS FLIGHT OPERATIONS ROUND TABLE

APRIL 1955 — ***Statler Hotel, Washington, D. C.***

Problems in Approach Lighting

Part II

"EVERY DAY *more and more pilots report that side lighting in overrun areas is confusing," said Capt. J. D. Smith (left)*

"PILOTS *do not want something that requires interpretation," reported Capt. Gill (right), seated next to Col. J. F. Taylor*

ROUND TABLE PARTICIPANTS

Moderator J. D. SMITH
Capt., Capital Airlines

RICHARD W. EGAN
Structural Concrete Products

JOSEPH D. BLATT
Asst. Adm., CAA

AMOS L. LEWIS
BuAer, USN

E. A. CUTRELL
Capt., American Airlines

JOHN F. GILL
Chief Pilot, Eastern Air Lines

DAVID S. LITTLE
American Airlines

COL. J. F. TAYLOR, JR.
Dir., ANDB

ROBT. J. ALPHER
Plant & Structures Br, CAA

FRANK B. BRADY
Air Transport Assn.

GEORGE K. CLEMENT
U.S. Air Force

ARTHUR E. JENKS
Flight Insp. Div., CAA

Editor's Note: Part I of "Problems in Approach Lighting" was presented in the March issue. This disclosed the lack of uniformity in approach lighting configurations at airports in the U.S., and the disagreement that currently exists between the military and the commercial carriers on what constitutes a configuration suitable for both jet and piston-engine aircraft operations. Complete agreement, however, was arrived at on the need for a full-scale evaluation of flush lighting before the problem of undershoot areas at joint-use airports could be solved. Part II, the concluding portion of the Round Table, considers the seriousness of 200 and ½ approaches and 200 and ¼ take-offs at airports where there are no centerline approach lights, and points the way to solution of this whole problem of approach lighting.

J. D. Smith: *"To insure safety in operations in and out of our U.S. terminal airports, we must consider the dangers in having to make 200 and ½ approaches and 200 and ¼ take-offs at airports where no uniformity in approach lighting exists.*

"Within the past week, I've made three 200 and ½ approaches and one 200 and ¼ take-off. And each time, on breaking out, I was faced with a different set of approach lights. Every day more and more pilots are reporting that side lighting on overrun areas is confusing and potentially a serious problem. But despite the fact that aircarrier pilots have been decrying this condition for many years, there still doesn't appear to be any sound method of getting rid of the confusion and lack of continuity that exists within the last thousand feet of the runway.

"Can we get some comment as to when it might be possible to eliminate the confusion during that most critical part of the approach? Art, what have you to say?"

Art Jenks: "The answer to that problem rests in our ability to get our point across to those at the right administrative level where action originates. At the same time, we must understand what the operating requirements are in the various fields."

J. D. Smith: *"Let's get down to the heart of this prob-*

lem, Art. Take Pittsburgh, where there is a modified Type B approach system being implemented. The criteria minimum will permit 200 and ½ operations for airline aircraft. Yet at that very same airport there are jet aircraft that will not use anything less than 500 and 1. In effect, 100% of the potential users at the 200 and ½ minimum will be subjected to something that was not intended for their use in the first place."

Art Jenks: "Now you are touching on another aspect, and one I mentioned earlier. Namely, you can't consider lights without exploring *all* the facets of the approach problem. You have used 200 and ½, and that's as rubbery a measurement as you'll find. We are always trying to decide just what is meant by 200 and ½—it's one of the difficulties which cause disagreement between pilots and engineers. They talk about design requirements for a certain type of weather, but the weather dimension is hard to pin down in operational use, because there is no way of measuring it exactly. Although we have made some progress, we still haven't nailed it down 100%"

J. D. Smith: "*Approach lighting is our problem . . . and it's a serious one. I have reports from pilots who admit they are misinterpreting these overrun areas. You just can't tell red overrun lights from runway lights on low-visibility approaches. The problem is there, what I want to know is how long are we going to permit it to continue?*"

Frank Brady: "As you all know, ATA has been much concerned with that specific problem. We've had a number of meetings and an extensive exchange of correspondence with the CAA. In fact, we have a clear statement in writing, made in good faith, that the CAA plans to implement replacement of the overrun configuration as soon as a suitable flush light is developed. Certain agreements with the military have to be reached to accomplish this, however, but there is serious effort being made in that direction. While there is a time element that none of us likes, we are on the right track to achieve our end objective."

A. L. Lewis: "I'd like to ask Mr. Clement whether or not and to what extent the Air Force is faced with the necessity for visibility off to the side, as a result of the need for placing armament in the forward section of military aircraft. If and when we go to a centerline system in the overrun, will the Air Force drop all thought of side guidance elements in its approach lighting system?"

George Clement: "That's difficult to say. At the present time, we have no problem of forward visibility in our multi-engine aircraft. The trouble we have in attempting to use any currently available fixtures on the centerline is the dragshoot. It's a problem that civil aviation hasn't faced yet. Jet fighter aircraft in straight-and-level flight have good visibility, much better than even the old 1940 aircraft. But in the approach our flare-out is much farther back than it is for piston-engine aircraft. Jets make their final approach and touchdown in a nose-high, power-on attitude, and that is when there is no over-the-nose visibility. The lateral visibility even at a fairly small angle off the centerline is good, but there's another little problem which enters into it and that is the multiple landing operation or the echelon landing. The planes come plunking down, one after another, and in 20 seconds more come in. If you give those pilots a runway 150 ft wide they gripe because it isn't 200 ft. You try a 300-foot runway and you get too many run-offs. What are you going to do? Frankly, until we get turbine engine driven aircraft from which you can get immediate thrust response, pilots are going to approach flared out, nose-high and with power on. Another problem is that of the angle of thrust and the tendency to more and more downward effect.

"For the over-all safety of aviation and to enable us to have lowered minimums, we must have a single standard.

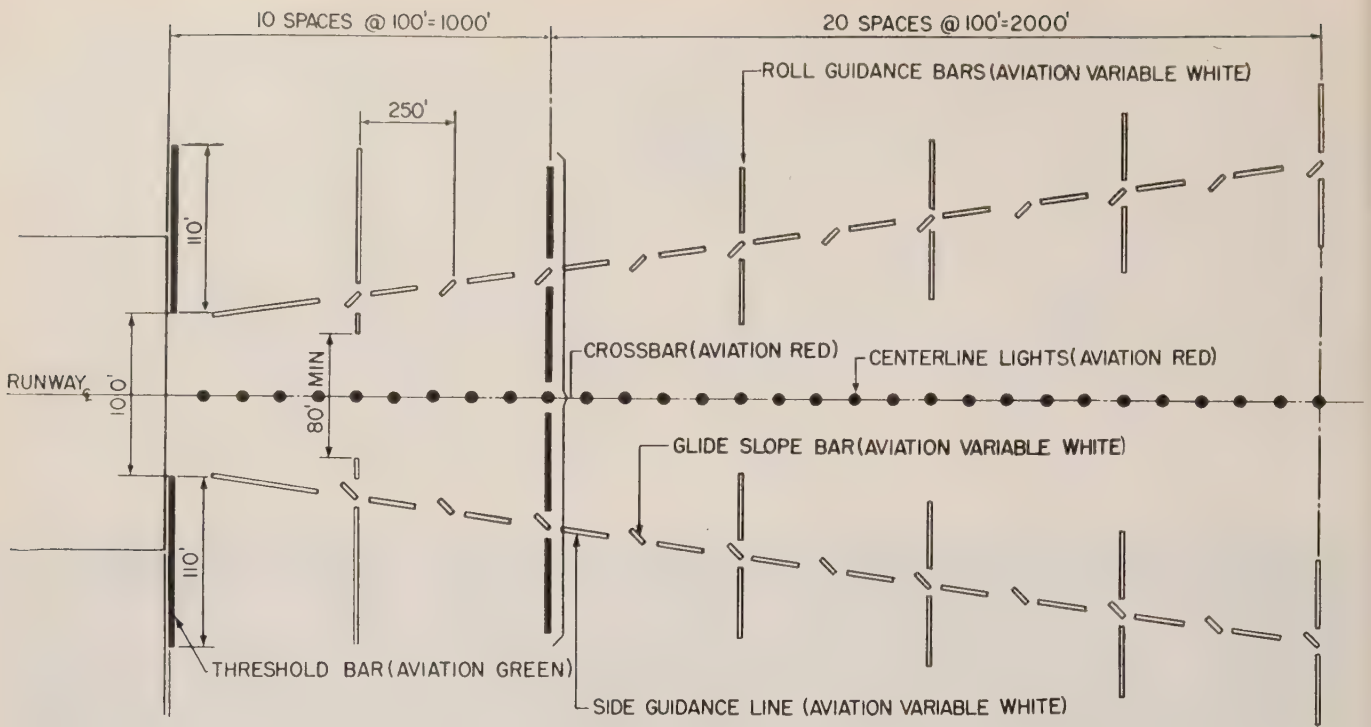
"Remember, we have certain statutory limits we must observe. We tell the Congress that we want a certain type of facility at a certain place. Then, when the Congress approves this program, we may not use either some other design or change the location; we must comply with the will of Congress as slated in Authorization and Appropriation Legislation. I think Bob Alpher and Art Jenks can both tell us a lot about that. It's something that you gentlemen in industry don't face."

J. D. Smith: "*All of us appreciate the problems of the military, but the men flying the airlines also have the problems of the passengers. It is difficult to convince people around a high-density airport of the advantages of protection when a high-speed aircraft might land on one of their houses. Somewhere along the line we're going to have an operation that is safe for both elements of aviation—commercial and military. It would appear, however, that the present trend is to help the military at the expense of the more experienced airline operations.*"

David Little: "I think we all will admit that any compromise can be carried only so far. If we want all-weather civil transport operations—and I'm sure the traveling

"FLUSH LIGHT *principle," stated Air Force's George Clement (left), "appears to be operationally the best for us"*

"AIR FORCE *and the CAA," reported Joe Blatt (left), "are in agreement except for that last 1,000 feet of undershoot area"*



TYPE C *configuration is primarily a Navy installation. It differs from both "A" and "B" in that it offers roll guidance*

military wants it as much as does John Q. Public—we can't compromise a safe civil lighting configuration to suit the optimum of military requirements. In my opinion, and with due consideration of the fact that we as taxpayers are vitally interested in national defense, it is of the utmost importance that the civil airport first be treated for its basic purpose—all-weather civil operation to the maximum of the safety its terrain and geographical characteristics may permit. When the military moves in for defense purposes, it should make the best of what they find at that terminal. Considering the normally higher military weather minimums, it's my further opinion that what we in civil aviation have been hoping for in approach lighting will not unduly compromise the tactical situation.

"I've listened to a great deal here today and frankly I'm disappointed to this extent: I still don't know when we are going to see in this country, purely for an operational test and not a nuts and bolts test, an underrun area installation of flush centerline lighting on a Type B approach light configuration."

Robert Alpher: "I believe I can answer that. We are hoping that our arrangements with the Air Force will make it possible to complete that installation for test purposes by late spring. There are many things that have to be negotiated—finances, equipment, etc.—but we are actively pursuing the problem."

David Little: "Those are words I've been waiting to hear. I am convinced from the installation in Amsterdam that we have a practical compromise in the principle of lighting that is being used there. I am extremely anxious to see that principle from a cockpit under the very lowest visibility conditions, just to be sure we are not overlooking some operational factors."

Robert Alpher: "Incidentally, we have had some problems in connection with the glide path at Knoxville which we are hoping to have corrected in time for the evaluation of the flush lights system."

George Clement: "In nearly all of the controversial installations that have been mentioned, the funds expended for approach light systems have been 100% Air Force funds. There have been no CAA funds involved. If there was no system at an airport, it was because that airport did not qualify for a CAA installation. As it is, you now have something where you had nothing before."

J. D. Smith: "*Mr. Clement, I would interpret that to mean that, inasmuch as we had nothing before and what you are putting in is considered better than nothing, we ought to be thankful for it? Is that correct?*"

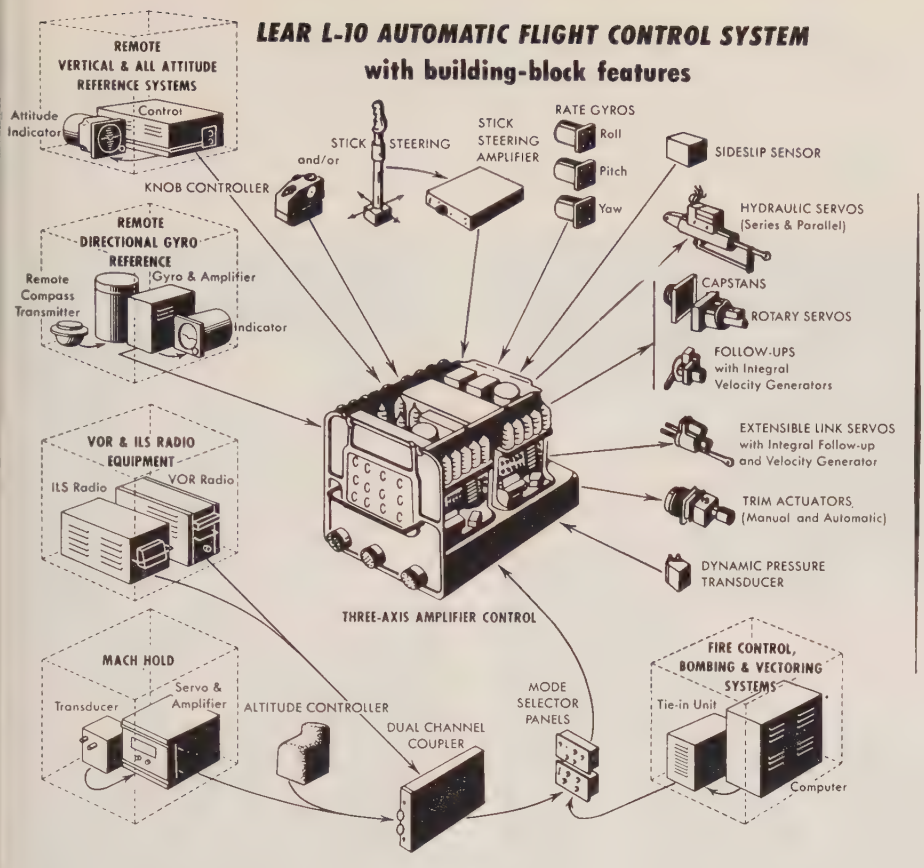
George Clement: "In part, yes. You don't consider Configuration B to be adequate. I said I thought that maximum operational safety could be obtained only through a single standard, and I'm going to bend every effort to effect that. However, I represent a very small pea in this whole pot full of peas called the Air Force. Remember that neither we nor the CAA can make a single installation unless Congress authorizes that installation. We tell them what kind of system we intend to install and we must install that particular system. We can't install some other kind. And, if after a certain period, we don't use the money, it is returned to the Treasury. We can't keep changing our minds and be in the position of going back to Congress for funds for newer and newer systems. We have to make up our minds."

John Gill: "I don't think you are happy, George, with the present undershoot-overrun lighting. Is that true?"

George Clement: "I'm not entirely happy with it. I believe we can work out a much better compromise, and I have much hope in this flush fixture. If we can get it and demonstrate to our Operations that there is no physical or mental hazard, we'll be on the right road. I don't believe a hazard would exist if we put a flush fixture down the centerline overrun, but in the minds of our boys they believe there's a hazard and you might just as well have tank traps there."

A. L. Lewis: "I would like to use the crying towel, too. We lighting engineers have to live with the monstrosities we call airports, not from choice but from necessity. We are doing the best we can with what is handed to us.

"One of our pressing problems has to do with the runway intersection, especially on those wide runways and with fighter-type aircraft. (*Continued on page* 31)



Lear L-10 Autopilot

A new flight control system designed by Lear to meet the special requirements of supersonic fighter-type aircraft is in the final phase of flight tests and soon will be installed on two operational jets for exhaustive military evaluation.

Designated the L-10, the new system incorporates basic components of the Lear F-5, the standard autopilot for the F-86D and the F-84E for more than three years, but is otherwise an entirely new autopilot. Important features of the L-10 include automatic Mach-number control, automatic "G" control, automatic heading selection, all altitude maneuverability, command maneuvering by control stick as well as by conventional controller, continuous sideslip control, and continuous automatic trim control for all control surfaces.

Usable amplifier gain in the L-10 is approximately 10 times greater than in the F-5 and the result is a very "tight" control-surface positioning loop. The new amplifier brings control surface positioning accuracy well within exacting tolerances required for supersonic flight.

Either the conventional console-mounted knob controller or control-stick force steering may be used for command maneuvering, with the L-10 installed. With "stick steering," the autopilot provides rate of roll in proportion to forces applied to the stick. When the desired bank angle is reached, the pilot relaxes the stick force and the L-10 automatically maintains the aircraft at that bank angle. The process is reversed to return to level flight, or the pilot may simply push a "leveling button" on the stick and the aircraft will return to level flight, locking on the magnetic heading existing at the instant the button is pushed.

The pilot may select a variety of automatic navigational control, singly or in combination, as follows:

Automatic approach control couples the autopilot localizer to glide slope and signals for automatic instrument approaches.

Altitude control may be used to hold the aircraft within a few feet of the existing barometric altitude.

Mach number control is engaged by keying a "Mach Hold" button. The aircraft then corrects pitch attitude automatically to maintain the flight speed at the existing Mach number.

Automatic Omnirange navigation is possible on any radio heading selected by the pilot. The selected course is maintained automatically through coordinated turning of the aircraft.

Guidance signals supplied by either ground or airborne aircraft armament systems will operate the Lear L-10 flight control system. The control-surface positioning loop provides good maneuvering accuracy for tie-ins with weapons systems, such as automatic fire control and automatic bombing.

Automatic damping of the lateral and longitudinal control modes is accomplished by the L-10 during periods of manual flight when the autopilot is disengaged. Separate electronic damping systems are not needed. The pilot is not aware of continuous damping by the autopilot except through the continued stability of the aircraft over the speed and altitude flight regimes.

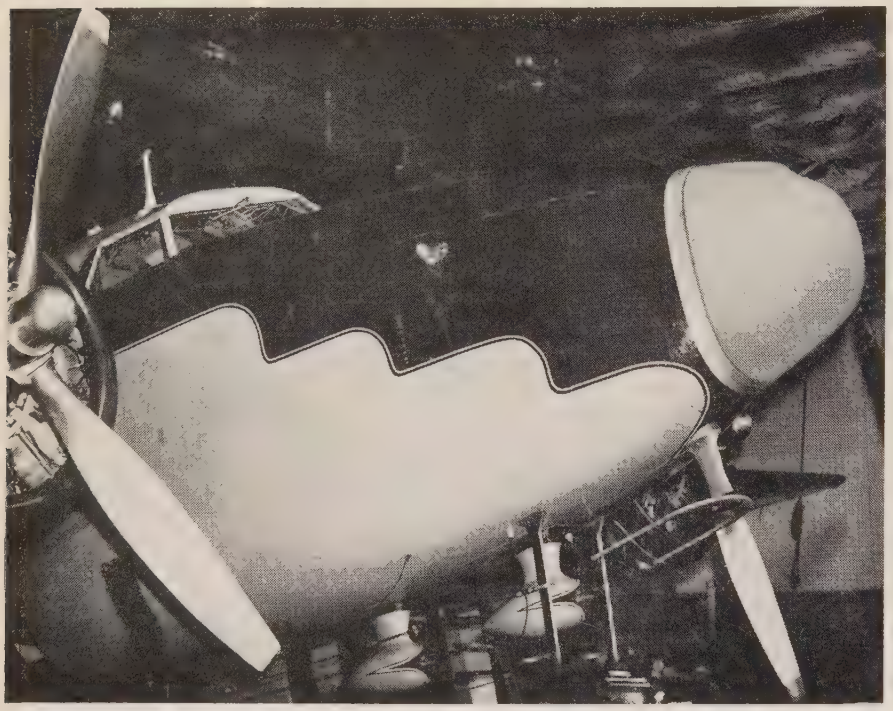
The ability of the L-10 to operate from remote gyro references, such as the Lear indicating vertical-gyro system for roll and pitch attitude reference, Lear Hi-lat compass system or any of the Lear stable platforms, is another important development. The weight and cost saved through the elimination of duplicate gyros in separate systems is considerable. Lear sees the L-10 as a significant step toward system integration utilizing the "master gyro" concept of aircraft instrumentation and control.

Lear deviates from conventional practice in the yaw stabilization of its new pilot. The function of rudder control is relegated largely to turn coordination. The chief purpose of rudder movement is to eliminate skid or slip originating from turbulence, asymmetrical power, loading or aerodynamic conditions. For heading control, the L-10 feeds azimuth error

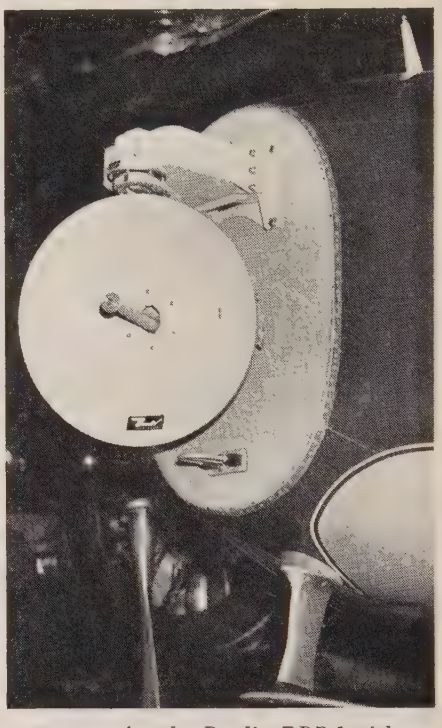
(*Continued on page 44*)

SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS



RADOME *in nose of the executive Lodestar is made of semi-transparent Fiberglas. Other nose section modifications included general beefing up and addition of bulkhead*



ANTENNA *for the Bendix RDR-1 airborne radar system was mounted in the nose*

Bendix Airborne Radar Installed in Lodestar

Rochester, N.Y. Page Airways, Inc., service and modification specialists at Rochester Airport, recently completed the installation of a Bendix RDR-1 airborne radar system in the Forrest Oil Company executive *Lodestar.* To accomplish the installation major modifications had to be made to the *Lodestar's* nose section, including a general beefing up and the addition of a bulkhead, in order to mount the antenna. The radome is made of semi-transparent Fiberglas. Page's engineering of this installation has been completely approved by the CAA.

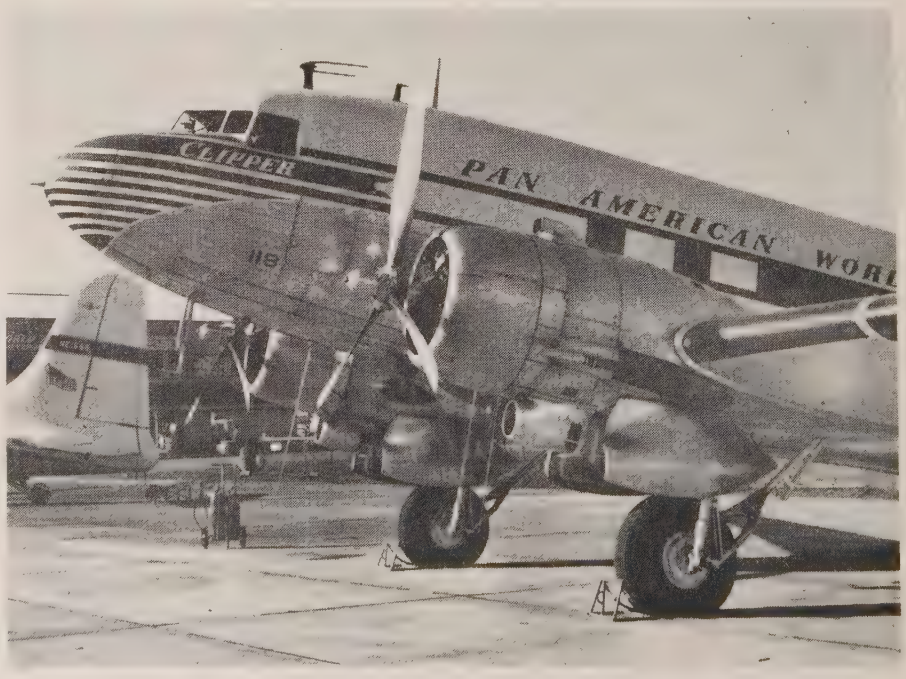
In addition to the RDR-1 installation, Page Airways installed a complete Bendix navigation and communications system and a DME. All work was completed in slightly over three weeks.

The Forrest Oil Company *Lodestar* is based at Bradford, Pa., and its pilot is Ray Johnson.

Page Airways is a member of the National Business Aircraft Association.

Pan American Designs New Landing Gear Doors for DC-3

Brownsville, Texas. Pan American World Airways' Customer Base has announced the design and CAA certification of new DC-3 main landing gear wheel well doors which offer the workhorse DC-3 a 10 mph (or 300 bhp) gain in cruising speed. The new doors completely enclose the wheel and tire and the smoothness of the door contour eliminates much drag. The door retraction mechanism is actuated by the gear itself and includes a fool-proof safety feature which prevents damage at a halfway point. The



NEW WHEEL WELL DOORS, *designed by Pan American's Brownsville base, gives DC-3 a 10-mph gain in cruising speed. Gear retraction time is 8 seconds instead of usual 21*

door is completely controlled by the gear, no matter what the direction of travel. The long aftpoints of the door are rigidly held by over-center "stiff-arms" which eliminate vibration or distortion. The rubber bungee is removed and replaced with a hydraulic bungee which adds to the retracting force. The hydraulic system is reworked to add even greater force to the retraction cycle. Average gear retraction time is 8 seconds.

A new oil cooler scoop was designed to smoothly fair-in the doors and exhaust the air out the sides rather than into the wheel well. The scoop is a universal type which will fit any of the three diameter oil coolers. This installation can be made on any model R-1830 or R-2000 engine. The 1820 requires a special scoop of aluminum, while the R-2000 is made of stainless steel to meet "T" category requirements for that engine.

Since the majority of DC-3's are flying with 1830 engines, the complete cost ($11,750) of the door installation is based on that engine. R-2000 installation is slightly higher because of the need for a stainless steel oil cooler scoop. The R-1820 is also higher since it requires a specially designed scoop for its vertically mounted oil cooler.

Performance-wise, the installation of these new wheel well doors offers a 10-mph gain at 700 bhp. The minimum speed gain is 8½ mph at 600 bhp. Gear retraction time is about 8 seconds as compared to the original 21 seconds. This offers greater safety for fast cleanup at V_2 to permit single-engine performance for a "go-around." Only 80 lbs is added by the over-all installation.

Court Decides Airport Cannot Prevent Rent-A-Car Delivery

Chicago, Ill. A precedent-setting court decision handed down by Judge Albert V. Bryan, of the U.S. District Court for the Eastern District of Virginia, has recognized the rent-a-car service as an integral part of public travel, which cannot be unreasonably interfered with by local airport rules. Judge Bryan ruled that management of the Washington, D.C., National Airport could not prevent an employee of Hertz from delivering a car to a passenger who had made an advance reservation.

Some weeks ago a Hertz employee was arrested for delivering a car to an inbound passenger who had made an advance car reservation and requested that it be delivered to him at the airport. Judge Bryan ordered the acquittal of the Hertz employee and stated that such deliveries to passengers had nothing to do with the airport manager's rights to regulate concessions. The Judge further stated that the Hertz employee's acts were in the performance of a personal right of and for a passenger and that the (airport) regulations do not purport to strip the passenger of his rights.

Capital to Fly the N.Y. Giants

Washington, D.C. The New York Giants recently signed a contract with Capital Airlines to fly to all of their league games, excluding Chicago-Milwaukee and Philadelphia-New York, during this 1955 season. The World's Champions' 24 trips will be flown in chartered DC-4's and *Connies*. On the homeward leg of the western swing, this often gives the team an extra day off.

. . . . in the business hangar

Sun Oil Company's new *Aero Commander 560* was delivered to Reading Aviation Service, Reading, Pa., for a major radio and instrument panel installation as well as a paint job. Radio installation included dual ARC Omni with the new Course Indicator, a Lear ADF-12, Collins 17L-4, 51X VHF communications system, a 51V-2 Glideslope receiver, Sperry C-2 Gyrosen system and H-5 Horizon, ARC range receiver, ARC isolation amplifier, ARC T-11B auxiliary transmitter and a Flite-Tronics marker receiver. The airplane will be based at Beaumont, Texas.

Luke Mosely, pilot for Pepsi Cola, has his company's *Lodestar* back in the air after installation of a second Collins 51R-3 receiver and 51V-2 Glideslope. The work was done by Air Radio Maintenance at LaGuardia Field, New York.

Alliance Manufacturing Company, Alliance, Ohio, has taken delivery of its first business plane, a DC-3 converted as an executive aircraft by L. B. Smith Aircraft of Miami. Features include foldaway tables and a built-in tape recorder, swivel contour chairs designed by Aerosmith, Inc., and panoramic picture windows. Pilot for Alliance is Capt. Bob Renneker; home base is Columbus, Ohio.

Don Beeler had Delhi-Taylor Oil Corporation's DC-3 at Executive Aircraft Service, Dallas, for 100 hour inspection and miscellaneous repairs.

Scott Paper Company named Wells Morrison Forbes chief pilot and Herbert H. Erdman, copilot of its new DC-3. Mr. Forbes was Chief of Air Carrier Operations Branch of Regional Hq, CAA, at LaGuardia Field before taking his chief pilot position with Scott. Mr. Erdman was manager of the airport at Hershey, Pa., and an engineering test pilot for Atlantic Aviation Service at New Castle, Delaware, on an RCA radar development project before joining Scott. Scott's new -3 is currently based at International Airport, Philadelphia.

Karl Styne, chief pilot for The Noland Company, brought his company's D18S to Piedmont Aviation, Winston-Salem, N.C., for 1,000 hour inspection and installation of a second ARC Omni. Karl is Noland's NBAA representative.

Coca Cola's DC-3 has been licensed for 26,900 gross. Rudder trim modifications, new manual, etc., was done by Remmert-Werner, St. Louis. Ralph Whitworth and Dick Young are chief pilot and pilot of the -3. Most of its operations are out of Atlanta.

Paul Jones, pilot of Shell Oil's (Salt Lake City) de Havilland *Dove*, has the aircraft back in the air after extra horsepower and gross weight modifications accomplished by Butler Aviation at LaGuardia Field, New York.

Gillette Company's *Lodestar* is back in operation after major modifications by Dallas Aero Service, Dallas, Texas. Features include picture windows, custom interior, automatic heat control system, 100-gallon auxiliary fuel tank, new instrument panel and installation of dual Bendix VOR, Glideslope, ADF, VHF, HF and ship-to-shore telephone. Panel work and radio installation was by Dallas Avionics. Gillette's chief pilot, Horace Wood, flew the plane back to home base (Boston's Logan Field) after supervising the modifications.

Harry Sievers and Ken Dougherty flew Standard Oil of Ohio's *Lodestar* to Spartan Aviation Service, Tulsa, for double engine and propeller change and fuel tank repair.

Bob Hamilton and Roy Pendleton had National Steel's B-23 and *Lodestar* at Page Airways, Rochester, N.Y., for installation of a Sperry Airborne Engine Analyzer system and annual relicensing. Both airplanes are based at Allegheny County Airport, Pittsburgh.

The Glenn L. Martin Co. has equipped its new *Aero Commander 560* with a Flite-Tronics MB-3 marker beacon receiver. Installation was made at Aero Design & Engineering Co. factory.

Harold Johnson, chief pilot for the Whirlpool Corporation, recently took delivery of his company's new C-50 *Twin Bonanza*. First stop for the C-50 was Roscoe Turner Aeronautical at Indianapolis where a Lear ADF-12 was installed as well as a Flite-Tronics marker beacon receiver, an R89B Glideslope receiver, an ARC Type 15D Omni, and a Turner modification of a Western Electric 733D transmitter.

The *Lodestar* belonging to Cappel-MacDonald & Company has been in the hangar at Grand Central Aircraft for installation of a Bendix PB-10 autopilot and a new interior.

TWA

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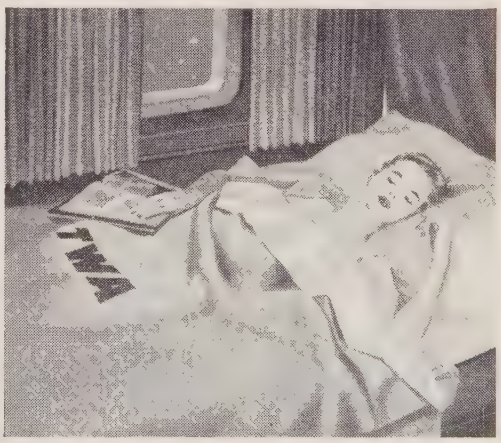

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Official NBAA Report

NATIONAL BUSINESS AIRCRAFT ASSOCIATION, INC.

(formerly Corporation Aircraft Owners Association)

National Business Aircraft Association, Inc. is a non-profit organization designed to promote the aviation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable business aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. NBAA National Headquarters are located at 1701 K Street, N. W. Suite 204, Washington 6, D.C. Phone: National 8-0804.

Tall Structure Committee Holds First Meeting

The Air Coordinating Committee has announced that the newly formed Industry/Government Tall Structures Committee has reached agreement on all of its agenda items. These items included an understanding of the character of the Committee, of industry-government participation, the issues and problems to be studied and the methods to be used in reaching the Committee's objectives.

The Committee, which CAA Administrator Fred B. Lee, and Federal Communications Commissioner Robert E. Lee, head as co-chairmen, was established by the ACC to identify and study the issues involved in the joint use of airspace by aviation and those who propose the erection of tall structures. At the completion of the study the Tall Structures Committee will submit its recommendations to the ACC.

The Tall Structures Committee is composed of representatives from both the aviation and broadcasting industries in addition to the various government agencies concerned with the problem of hazards to air navigation created by television towers and other high structures.

NBAA is a member of this committee and is strongly opposing indiscriminate construction of tall structures, particularly those exceeding 1,000 feet in height in the vicinity of airports and airways.

Joint Congressional Committee Urged to Probe VOR/DME-TACAN

One of the latest developments in the long-heated civil-military dispute over VOR/DME *vs* TACAN air navigation systems, is the proposal of Senator Styles Bridges (R-N.H.) to create a joint committee of both branches of Congress to fully investigate the complex issues involved in the controversy.

As ranking Republican on the appropriations and the Armed Services committees, Bridges referred to "recurrent rumors of possible irregularities" involved in the controversy. He stated that the implications for air safety and for national defense and security, as well as the large development costs for TACAN, was justification for the investigation.

Senator Bridges explained that he had "no preconceived notion as to which side of this controversy is right and which is wrong." He added that the decision for a common system of air navigation for civil and military purposes resulted from recommendations of the old Joint Congressional Aviation Policy Board. Therefore, he declared, both branches have an interest in investigating this matter.

Bridges further said: "I understand that the TACAN system of navigation admittedly requires further development at great and substantial costs, and the fact that we must discard some hundreds of millions of dollars worth of proven equipment of the common system now in existence and in operation causes me great alarm." He referred to a news release that said the military's TACAN procurement involved up to $326 million in production commitments alone.

As a result of his own observations during extensive air travel and numerous discussions with pilots and aircraft owners, Bridges indicated that the present common system is performing "the necessary job . . . for safe, efficient and reliable air transportation." He was concerned that TACAN proponents indicated further development was necessary to bring the projected new military system to the degree of reliability now existing in VOR/DME.

Bridges said that the current ANDB proposal was to discontinue a major portion of the VOR/DME system by July 1, 1955, and to schedule its complete discontinuance on or before 1965.

Following the delivery of his senate speech, Bridges again emphasized the possibility of "irregularities" involved in the dispute. He suggested that his colleagues, too, must have heard the rumors around Washington and the nation.

"No one can just laugh this off," Bridges admonished. "The bad air accidents which may be caused, with their hundreds of deaths, will set off a great hue and cry around the country. And the navigation system is the key to our military, civil and private aviation."

Senator Bridges' blast stemmed from the series of formal congressional investigations started during March in the House and Senate to get to the bottom of the disputed Air Navigation Development Board's recommendation that TACAN be adopted as a common system objective on or before 1965. Hearings mostly have been held in "Executive Sessions" because of the "classified" nature of the technical issues. The House Government Operations Committee Sub-Committee on military operations, House Interstate and Foreign Commerce Committee Sub-Committee on transportation and communications, Senate Interstate and Foreign Commerce Committee, have called as witnesses top brass from the Defense Departments, Commerce, CAA, FCC, ACC, ANDB, and the State Department. These committees are seeking reasons from the military why certain actions were taken and large expenditures were involved in developing an "untried and unproven" military tactical air navigation system after a joint agreement had been previously reached between civil-military agencies on VOR/DME as the "common system."

First official statement on the background of military development of the disputed TACAN navigation system was made by Assistant Defense Secretary Donald A. Quarles before the House Committee on Government Operations. During two hours of questioning by that group's Military Operations Sub-Committee, Quarles disclosed that the Navy TACAN work started in February 1947 before civil VOR and DME were systems in existence. He further said that from 1949 to 1951 development was continued on a "classified basis" for important tactical uses and to preclude compromise.

Quarles, who also serves as chairman of the Air Navigation Development Board which recently released the much-disputed pro-TACAN decision, added that knowledge of the Russian A-bomb explosion and the Korean hostilities only intensified the military requirement while permitting no relaxation of security. He pointed out that although ANDB development of VOR/DME at the time was proceeding along lines technically incompatible with TACAN, "no one devised a way to bring them together."

Quarles then referred to the reorganization of the ANDB, its Vortac Committee study, and final decision as the "best escape from this dilemma." He said that it would be least costly to the taxpayer, best satisfy the needs of both civil and military aviation, and "even with its uncertainties" has the greatest potential for common system use. As to civil DME, he stated it had not been accepted generally—that estimates of sets in the hands of users ranged from 90 to 220—and that this was a relatively small number compared with 40,000 to 50,000 sets of VOR.

Questioned as to action by the Assistant Defense Secretary for Applications Engineering in TACAN procurement, Quarles said that office had entered into the situation and, as a result, service procurement has been "substantially modified."

Cole H. Morrow, NBAA member of the ANDB VORTAC Committee, in testifying before the House Interstate and Foreign Commerce Sub-Committee on Transportation and Communications, gave the following "unclassified" statement:

"The opportunity to appear before this

MEET THE NBAA MEMBERS

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Committee is very much appreciated. The matter you are considering is of far-reaching importance and the conclusions and recommendations you make after these hearings will affect aviation for many years to come.

"As to my qualifications to comment on the matter before you, I submit that I was the NBAA representative member on the VORTAC Committee and have studied and analyzed all of the factual information available on both VOR/DME and TACAN. Also I am a registered professional engineer and a currently active commercial pilot.

"The large amount of information, data, black boxes, charts, technical gobble-de-gook; (most of which is irrelevant) may seem to confuse the issue, but actually it is very simple. The real issue is, do we have or have we ever had the common system which Congress and the civil users thought we had and for which Congress appropriated large sums of money to implement?

"If the military can force on the common system an incompatible tactical system that has been secretly developed and which has not been coordinated through the proper channels such as ACC, ANDB, RTCA, etc., and thereby destroy the common system which *has been* properly coordinated and accepted and agreed to in these same agencies by the same military representatives, then our democratic form of government is in jeopardy. This is exactly what we face today in the VOR/DME-TACAN controversy. Congress should not and cannot allow such a situation to occur as it can only lead to chaos.

"The RTCA SC31 report in blueprinting the common system stated that tactical requirements could not and should not be met by the common system. NBAA believes this is a sound policy and further we do not believe it is in the best interest of national defense to consolidate tactical equipment in the common system. Our common system should be common worldwide if possible and this has been accomplished with VOR/DME through ICAO agreements. On the other hand, any military tactical system should be a jealously guarded military secret. If made a part of the common system, security is gone and it is no longer ours.

"Our hard-won common system, including internationally agreed to VOR/DME, must not be abandoned in 1955. It should be nourished and improved so that we may get a "return" on the investment we've already made. Eventually, of course, it may be replaced by a more advanced system. Let us, however, hang on to the system which we have proclaimed to the world until we really have something much better. Meanwhile, who can deny the services need for their *own* secure method of short-distance navigation system?"

The State Department has asked the Air Coordinating Committee for clarification of U. S. policy on short-range navigation aids in light of the recent Air Navigation Development Board VOR/DME-TACAN report. In its formal request, the State Department pointed out that the U. S. has gone to considerable effort in selling VOR/DME abroad and asked that ACC examine the issue as a matter of urgency to clarify future policy.

The request by State is the second to be received by ACC. A similar petition was submitted by the Radio Technical Commission for Aeronautics to clarify both the domestic and international implications of the ANBD action reached by the ACC. RTCA in its exploratory discussions of the ANDB VOR/DME-TACAN dispute, has set up a special committee to determine frequency channel requirements for a common system short-range navigation aid. RTCA's step opens the way for an answer to one of our points raised by ANDB consultants in their report on TACAN to the VORTAC Committee. It was recommended by the Consultants that, before any widespread use is made of TACAN, a study should be conducted to assure that it can provide the total number of interference-free channels required for common system operations.

Other than this specific request, the RTCA discussions were purely exploratory in nature.

In a letter to all U. S. airline presidents on the VOR/DME-TACAN dispute, Henry W. Boggess, Chairman of the National Business Aircraft Association, stated that "largely because ATA's VORTAC representative failed to evaluate your interests and to vote for those interests in the VORTAC Committee, the nation's airlines

(*Continued on page* 30)

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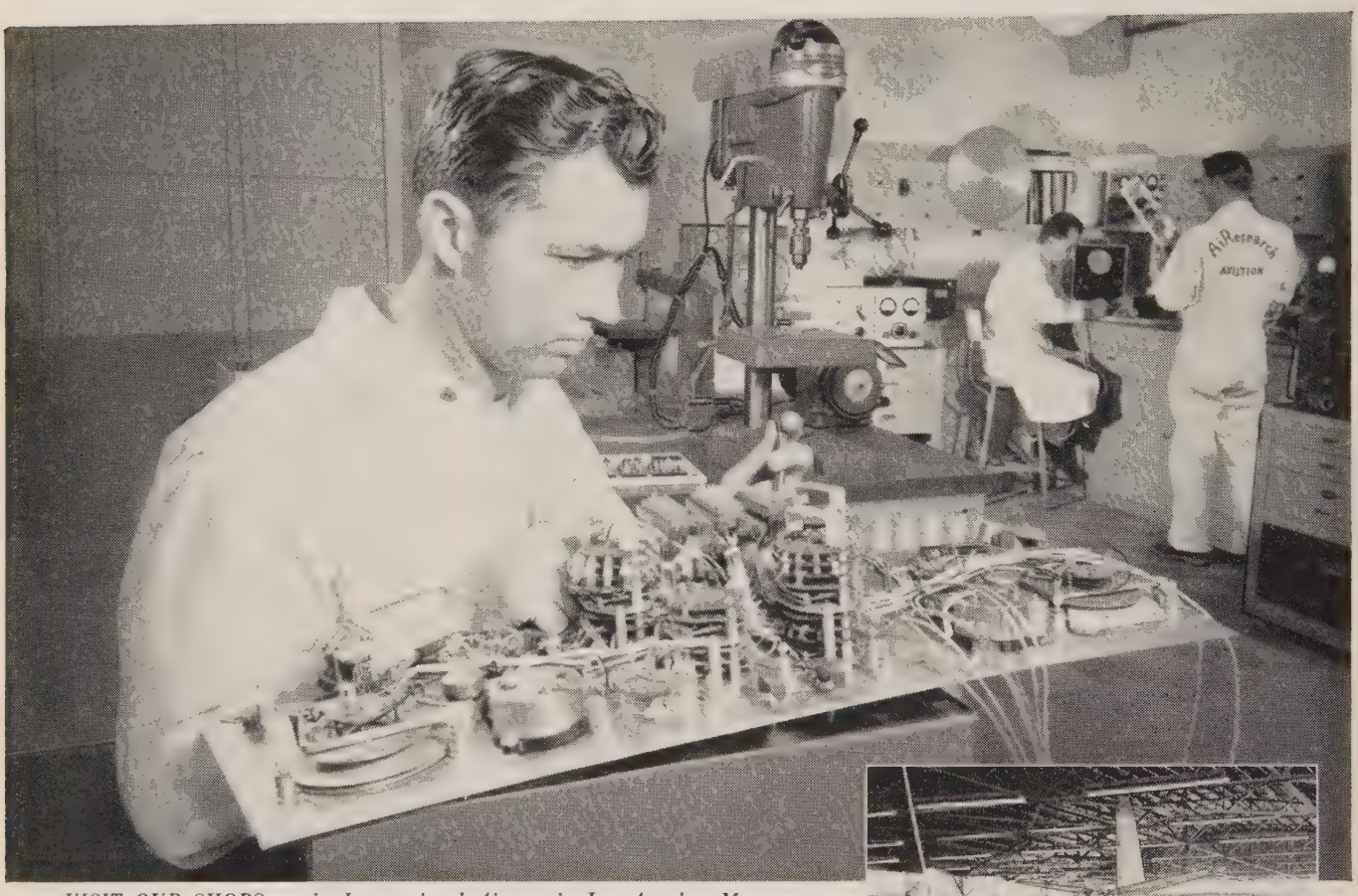

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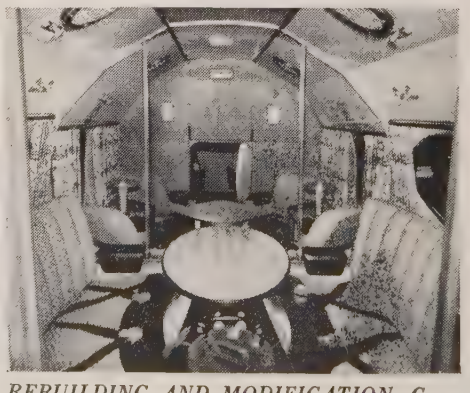

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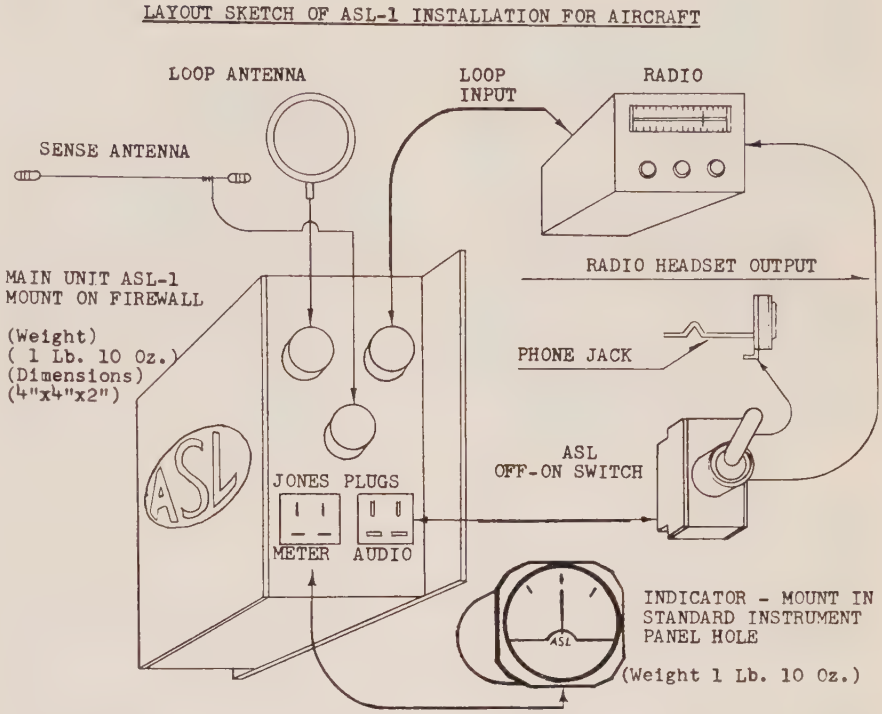
CAA Warns of Unauthorize Use of an ILS Glide Path

The Office of Federal Airways has issued a bulletin to all users of airways and approach aids noting that certain navigational facilities are being used for purposes for which the facilities were not designed and which could result in hazardous situations if continued.

For example, a number of pilots have submitted comments to control personnel as to the flyability of the *glide path* while making *back course* ILS approaches. All authorized instrument approach procedures involving use of the back course have been restricted to flying the localizer portion of the ILS system, and then only when that back course has been check-flown by the Airways Flight Inspection staff of CAA and found to meet established safety requirements. Nevertheless, in some instances, glide path transmitter sites have been found to be emitting sufficient radio frequency energy in other than the intended direction (along the front course of the localizer) to activate and lower the glide path needle warning flag in an aircraft cockpit indicator. And usually the instrument will show a fictitious indication of *"on glide path,"* regardless of altitude! Thus, some pilots encountering this condition have assumed erroneously that a reliable glide slope signal existed at facilities where back course localizer approaches have been authorized. Any pilot can permanently dispel this dangerous notion by simulating a back course approach in CAVU weather at any facility where such spurious signals are received.

Another mis-impression evidently exists with respect to the safe employment of the front-course ILS glide path, beyond the limits prescribed in the approved approach procedure. At least one pilot has been quoted as having intercepted the glide slope over mountainous terrain at a considerable distance from a facility location and, utilizing the glide path indication as a let-down aid, descended below enroute or transition minimums prior to crossing appropriate fixes established for that purpose! Where such a procedure has not been authoritatively checked and approved, it is obvious that such an "improvised procedure" is strictly non-habit forming! (As quickly as the responsible agency determines that a need for such a let-down procedure exists and careful analysis and actual flight-checking indicates that required safety margins are not compromised, such use of ILS let-down would be approved and published. For example, the straight-in approach from the south intercepting the Salt Lake City ILS Glide Slope on Amber 2 airway at enroute minimums and over the Riverton Fan Marker where interception altitude can be checked by the pilot before continuing let-down straight-in to the final approach.)

But in general, where CAA has not authorized such use of a glide slope facility, no assurance can be given as to the reliability of the signal received. In addition, obstruction and terrain clearance tolerances maintained with respect to the intended and limited use of the facility could be wholly lacking at any and all points beyond the specified approach limits. *In short, use the ILS glide path signal indication only within the approved and detailed limits set forth on your up-to-date Jeppesen and RF approach plates.*



ASL-1 *makes radio compass of LF receiver. Panel indicator is turn-toward-needle device*

The ASL-1 Now Makes Every Radio A Homer

In the midst of the controversy raging over the VHF navigational system, it is very easy to overlook the importance of the very extensive LF/MF radio navigational facilities already existent and still on the increase. This includes the known fact that the familiar 4-course LF ranges are still being eliminated *albeit* somewhat more slowly as a result of public resistance. What is referred to is the increase in the number of LF radio beacons.

Low frequency as a communications band, traditionally the least satisfactory since the advent of VHF, is still in the picture but almost entirely as an alternate facility in the event of VHF failure. (Virtually all private and business-class aircraft of postwar make are VHF-equipped on delivery or immediately thereafter.) With the steady decline in the number of requested calls for reply on LF frequencies made to towers and airways stations (CAA makes repeated check surveys of this), a good case may soon be made for elimination of this LF facility entirely.

Therefore, it is of considerable importance that attention be called to the availability and value of equipment of this nature already in possession of the general flying public, when converted to the equivalent of a radio compass by a comparatively easy and inexpensive accessory now available. The large airline-type equipment operators long ago came to this conclusion and only the fact that investment well in excess of $1,000 was a minimum requirement prevented many owners of smaller aircraft used primarily for business and pleasure from following suit. Even those owner-operators to whom the above investment was not too much a deterrent to installing a single ADF, found the duplication of same, however, attractive and advantageous, a little too much to bite off.

So, the advent of conversion equipment of a reliable and practical nature that could make a 100% navigational device out of every existent LF receiver is good news to all operators of aircraft not already dual-ADF equipped. The obvious advantages of loop homing are apparent to every pilot after his first basic cross-country. The discouraging inconveniences of old-fashioned fixes or rotatable DF loop homing procedures are such that for all practical purposes, they have gone the way of helmet and goggles, boots and scarf, protractor and divider. The lad who gets outside of a 25-mile radius of base with a non-radio-equipped *Cub*-type airplane meets the same mixed-emotion attention on landing at a strange airport that motorists give the fadist on the highway with his Stanley Steamer.

Being committed to radio-navigation, with pilotage and dead-reckoning as our spare tire only, there is no excuse for the pilot who flies with less than the maximum available in equipment, limited only by practical financial, space, and weight considerations. In that light, every LF receiver should be automatically capable of giving directional guidance with respect to any station to which it can be tuned. And if the medium and high frequency broadcast stations are also included in its capacity, their value as high-powered navigational beacons, used with appropriate discretion and moderate skill, are an added premium to the comfort and safety of practical cross-country.

The ASL-1, Automatic Station Locator offered by Aircraft Specialty Lines, 10200 N. 19th Avenue, Phoenix, Arizona, is not the first, nor will it be the last, low-cost electronic direction finder on the market. The important fact is that it is accurate, reliable, low-cost, light-weight and easily added to the most existent LF receivers.

Competently handled, which is no chore, the ASL-1 will measure off-heading deviations in the amount of one degree, given a reasonably good LF signal. Since it employs a mechanical reed switching system instead of vacuum tubes, its chances of malfunction are claimed to be very slight. Employing a fixed-loop system similar to the old pre-war Bendix but of modern and miniatured design, the ASL-1 nevertheless resolves its own ambiguity by addition of a sense an-

Air-Aids Spotlight

CAA Request—On IFR plan, when making position reports, after giving estimate of time over next fix, *add name of next succeeding enroute fix* for flight plan and ARTC clearance route confirmation.

CHARLOTTE, N.C.—*ILS Outer Compass Locator should now be on 242 kc.*

CHICAGO Area—Watch for new and unfamiliar local routings since influx of several new VOR facilities in addition to the TVOR, JOLIET ("JOT") 114.4 mc; PEOTONE ("EON") 112.8 mc; POLO ("PLL") 112.3 mc. Also southwest towards ST. LOUIS; ROBERTS ("RBS") 116.8 mc (north of CHANUTE).

CLEVELAND, O.—*VOR frequency change due, to 113.6 mc.*

DETROIT, Mich.—*DETROIT BVOR decommissioned and moved south of both airports to CARLETON (new designation) ident "CRL", same frequency 114.9 mc.*

GREAT FALLS-HELENA, *Mont.—These two LFRanges swapped frequencies; "GTF" now 371 kc, and "HLN" now 317 kc (DILLON "DLN" on 397 kc only 95 mi!).*

LAKEHURST, N.J.—*LFRange changed from 520 to 396 kc.*

MIAMI AREA—*BLUE 19 airway extended southwestward direct KEY WEST, coincident with VICTOR 3; and north leg HOMESTEAD LFR swung eastward to lie just east of MIA INTL ARPT along the departure route detouring approach traffic southwest and west-bound.*

MEMPHIS Area—*BLUE 46 airway to DYERSBURG swung northward to intersect north leg MEMPHIS and northwest leg NAVY MEMPHIS, to give wider berth to Navy aerobatic training area.*

PITTSBURGH, Pa. — *Planned decommissioning of Runway 32 ILS and relocation (incl. approach lighting) to Runway 28 approach (quoted Feb. issue) postponed indefinitely. At press time, glide slope on Runway 28 approach still non-commissioned. Until commissioned, original procedure and straight-in minimums of 400-¾ still applicable. Watch JEP & RF.*

ROCKY MOUNT, N.C.—*VAR (Visual-Aural range) decommissioned; to be replaced shortly by VOR on 115.9 mc at virtually same location.*

SALT LAKE CITY, Utah—*Straight-in let-down and approach on ILS authorized from the south on interception of glide slope at 12,000 ft (enroute minimum) on AMBER 2 at RIVERTON intersection. (See article "Unauthorized Use of Glide Path").*

VANCOUVER, B.C.—*In addition to recent re-assignment of airway numbers in this area, the east leg of NANAIMO LFRange has been swung south (250°) to cover WESTHAM intersection; initial approach read WESTHAM instead of VANCOUVER LFR.*

PILOTS PLEASE NOTE—*In the March issue, Navicom Section, under the title "New York & Philadephia Preferential Routing List," the line "Outbound IFR Flights—New York ARTC Area" was inadvertently omitted! Please insert on page 29 after "via NORFOLK" and before "NORTH" (lines 19 and 20) the following:*

OUTBOUND IFR FLIGHTS * * NEW YORK ARTC AREA

Destination	From	VOR Route	LF Route

tenna, so that the pilot is only confronted with the simplest basic homing problem. Range is in the order of 100 to 150 miles on a 5,000 watt broadcast station, and 20 to 80 miles on an LF radio range station or medium-power beacon. Cost is $195.

As with an ADF, the desirability of making good a straight track is always a question, and especially so with a purely Left-Right reading device. The gap between the ease of doing this with a full azimuth-reading radio compass and the ASL-1 is easily computed as much less than the gap in the comparative cost of the two equipments! And for all practical purposes of the smaller business or private aircraft for which the ASL-1 is primarily designed, a close analysis of the curved track calculated to be flown in simple homing as a result of crosswind, shows that the additional time required to home under the most unfavorable conditions, with a ratio of 30% crosswind component to airspeed, is only 5% over tracking time on a direct course!

And, if the ASL-1 is employed to add direction-finding to a second LF receiver in addition to a separate complete ADF system, the advantages of dual ADF for accomplishing a desired track adequate for low-visibility approach purposes is attained, plus the bonus of fast, pin-point position fixing at all times enroute X-country.

New Bantamweight Power Unit Announced By Lear

The uses to which corporation aircraft are put exceed in variety even the number and types of airports and localities into which they have to fly. Hence, it is of consequence to consider not only the possible need for an adequate power source for portable field lighting, but also occasional auxiliary portable power for prime movement of heavy loads into and around working aircraft. (Such as on remote fields, where ground-based hoists or heavy lifting equipment is not readily available and use of aircraft battery power not desirable.)

George Otis, Vice President of Lear, Inc., announces the first of a complete line of lightweight portable electric power generators that are to be produced and sold by the LearCal Division in Santa Monica, Calif.

The Model 5900-B is a completely self-contained gasoline engine-driven generator package which supplies 26 volts DC at 50 amperes continuously. It weighs approximately 30 pounds and occupies no more than a cubic foot of space. It has a carrying handle and is equipped with suction-cup feet that, in addition to damping vibration, keep it from shifting around when operating or when stowed away. While designed primarily as auxiliary equipment to be carried aboard aircraft and for ground use around airports, this compact electric powerplant is suitable for lighting, operating electric motors, heaters, air conditioners, supplying power for radio communication or charging storage batteries.

LEAR *portable power generator weighs 30 lbs*

Fuel consumption is less than a half gallon per hour. The engine has an automatic rewind starter and is equipped with a muffler. Specifications for this model and others ranging from 12-volt to 110-volt systems may be had by contacting Lear, Inc., LearCal Division, 3171 South Bundy Drive, Santa Monica, California.

New LaGuardia-Albany and North Routing Announced

Effective the 1st of this month (April), the time-worn groove traced out by countless Colonial Airlines and corporation aircraft northbound out of LaGuardia Airport via Paterson, N. J. and the south course of Poughkeepsie LFRange, usually involving a stiff climb, will be replaced by a GLEN COVE (E/LGA int. of NE/IDL) WILTON VOR V-91 to POU, or GLEN COVE, HUNTINGTON (E/LGA int. S/BDR) BLUE 66 to POU routing. Climb-out will be eased by the 2500- and 3500-foot levels used on this well-known BOSTON and New England air route.

Ironic is the fact that this move could open a low-altitude south-bound for Mohawk Airlines "tunneling" under LaGuardia Airport's northwest-bound traffic over Paterson, N. J., previously held to 8,000 feet and above, then "dumped" over Newark. Added irony is the fact that Mohawk has just announced replacement of their slow-descending DC-3's by pressurized Convairs on this route! Executive aircraft inbound to NEWARK will still profit.

Perfect as a basic communication set, perfect as a second, separate auxiliary radio, the NARCO Simplexer is a versatile unit with wide-band 12 channel VHF transmitter (108-127 megacycles) and VHF receiver.

Its exclusive "whistle-stop" tuning feature lets you find desired frequencies with the same positive precision as with far more expensive crystal-controlled receivers.

Thousands of dependable, ruggedly-built Simplexers are in daily use in multi- and single-engine business planes. For reliable, dependable long-distance communication, specify Simplexer. Compact, easy to install.

This 2½ pound "pancake-designed" Omniplexer can be plugged into any existing Simplexer to give accurate Omninavigation. Dual function left-right/to-from indicator contributes to compactness; vernier control assures accurate course selection.

The Omniplexer/Simplexer combination provides a perfect navigation and communication package and permits addition of dual Omni at surprisingly low cost.

Omniplexer attachment . . . . . only $195

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Approach Procedures Explained In Bulletin

One of the great problems facing many corporation and executive pilot crews is the difficulty of keeping abreast of all procedural information bearing on their operations. Because of the spirit of cooperation expressed by executive leaders of ATA and ALPA at the NBAA meeting in Dallas last year, it is possible to glean from the acknowledge experience of these two groups many things that are of mutual benefit and concern to other organizations whose pilots fly similar equipment and who are confronted with similar problems.

One of these problems is a better understanding of just what goes on during Radar Approach procedures. Apparently contradictory clearances become less so when properly understood and the advantages of radar in providing more efficient yet safe use of airspace become more apparent.

In a recent ATA bulletin, disseminated widely within ALPA as well, it was pointed out that considerable confusion among pilots has resulted from the phraseology "Cleared for ILS approach, maintain ..... thousand feet, leave ..... on a heading of ..... degrees." This has been used when clearing aircraft in from the feeder fixes by radar vectors to the ILS localizer course. Some pilots have felt that a contradiction exists when cleared for an approach and also told to maintain an altitude and fly a certain vector. Similarly, they have questioned the fact that more than one aircraft may be "cleared for approach" at the same time, and wonder what may happen if radio failure occurs.

For the purposes of a radar-fed approach system, the pilot is considered to be on "initial approach" when he is on the vector so assigned by radar. In the event he loses two-way communication while on such a vector or initial approach, it is expected that he will proceed direct to the ILS Outer Marker/compass locator or radio station via which the approaches are known to be in progress and effect an approach. Immediately upon realization that a radio failure has occurred *(the radar standard of 60 second maximum on initial approach is implied here—Ed),* the controller will take action to assure continuance of the required separation of all other aircraft from the radio-failure aircraft on the basis that that pilot will continue his approach.

The maintenance of an assigned altitude upon a radar vector or initial approach until a change or further let-down is received serves especially as a safety factor in event of a radio failure so that the more-than-one aircraft cleared for approach are not in conflict. This then is discarded once adequate separation is assured on the final approach as a result of the vector or initial approach heading.

Urge Probe of VOR/DME-TACAN

(Continued from page 25)

will suffer with other users of the airspace.

"If ANDB's recommendation is implemented," his letter continued, "it seems apparent that all civil users of the airspace will face serious safety problems and economic loss . . . it seems untenable that our existing system can be replaced by an unproven and experimental system which, even if perfected will be without communications channels and will require separate low-approach and landing installations.

"Civil aviation is being asked," Boggess concluded, "if not told, to trade its present satisfactory navigation system (and attending public and private investment) for an undeveloped and classified system which ultimately offers less operational advantage and at great additional cost . . . air transportation must have stability in its navigation system; the military's tactical needs demand flexibility for radical change as required . . . "

As new developments occur, we will keep you posted through this report. When all is said and done on this issue, the leading role of NBAA in strongly challenging the arbitrary ANDB decision will become fully known. The battle is raging and both sides are bringing to bear their best strategy. We believe that NBAA's stand is right and we will continue to oppose to the utmost the military's attempt to replace or abort VOR/DME with the still untried and unproven TACAN system.

Sinclair Annual Aviation Conference Outstanding

According to the Sinclair Aviation Department publication *"Flying with Sinclair,"* its recent fourth Annual Aviation Conference was the most stimulating and informative of any previous ones held by the company.

There were 21 subjects on the agenda, ranging from what a conference should mean through qualifications of a business pilot and how to obtain and retain pilot proficiency to the technical phases of flight operations and maintenance problems. These subjects were presented by Sinclair aviation flight and ground personnel. There were questions following each topic which brought out many more enlightening points for information and guidance.

Included in the attendance were the entire personnel of the aviation department, four observers and a guest. Dr. Theodore O. Law, Professor in the School of Business Administration, University of Oklahoma and Assistant Director of the Bureau of Business Research and who at the present time is directing a research project on aviation for this bureau; Jean H. DuBuque, Executive Director of National Business Aircraft Association, Washington, D.C.; Rex Cowen, until recently Aircraft Dispatcher for the Sinclair Pipe Line Company and now Assistant to the President; and Harold Bailey, the new Aircraft Dispatcher for the Pipe Line Company, were the observers. Russell Biegel of the Champion Spark Plug Company, Dallas, Texas, was a special guest for the second afternoon session, giving an informative discussion at the Sinclair annual banquet on the make-up and function of aircraft spark plugs.

Piloting—Good or Bad?

There is no automobile in the world that cannot be wrecked by bad driving. There is no aircraft—military, acrobatic, or otherwise—that cannot be pulled apart in the air by *bad piloting.*

At any speed greater than twice stalling, you can tear the wings off any commercial plane. The higher the speed in ratio to stalling, the more easily limit and ultimate stresses can be exceeded. The cleaner the plane, and the more efficient the design, the more quickly it can reach dangerous entry speed.

Ninety-six per cent of all 1948-1953 mid-air "structural failures" were caused by pilot handling—60% of these resulting from violation of CAR's.

A good rule-of-thumb to remember when the going gets rough and excessive turbulence is encountered is to slow up to approximately twice the aircraft's stalling speed—considered generally safe for any conditions under which the aircraft can be flown.

Remember also, the greater the degree of bank, the higher the stalling speed becomes.

New NBAA Members

Texas Gas Transmission Corporation
Owensboro, Ky.
NBAA Rep: Kenneth G. Jolly, Manager
Company operates: Beechcraft D18S, *Bonanza* C35, *Bonanza* A35

Gardner-Denver Company
Quincy, Ill.
NBAA Rep: John I. Belmeyer, Chief Pilot
Company operates: Beechcraft D18S

Socony-Vacuum Oil Company, Inc.
New York, N. Y.
NBAA Rep: Charles E. Morris, Mgr. Aircraft Operations
Company operates: 3 Douglas DC-3, 4 Luscombe, 3 Beech D18S, 2 Cessna 170, 2 Cessna 18, 2 Cessna 195, 2 Aero *Commander,* DeHavilland *Beaver,* Bell Helicopter 47G, Beech C35

Rock Island Lumber Company
St. Paul, Minn.
NBAA Rep: L. J. Koons, Chief Pilot
Company operates: Lockheed *Lodestar*

Cosden Petroleum Corporation
Big Spring, Texas
NBAA Rep: W. K. Edwards, Chief Pilot
Company operates: DeHavilland *Dove, Bonanza*

Skyways Round Table

(*Continued from page* 18)

At Patuxent River, we have a threshold and on the left-hand side 800 feet of no lights. On the right-hand side there are 600 feet of no lights coming out of a bright approach lighting system. What do you do with that?

"We also have the problem of providing a bounce platform to simulate a carrier deck and getting lights out there to help train our people. So far we haven't had anything but flashlights, although we do have a lighting development contract for retractable runway lights to outline carrier decks in the middle of these runways."

George Clement: "I'd like to emphasize Al's remark on this intersection problem. Let me suggest that you take the 'Pilot's Handbook' and look at the intersection conditions shown. These layouts aren't too good as the scale is about 1,000 ft to the inch. They may be pretty good pictorial representations but they don't show detail. Just look at the Eastern United States, taking in the military as well as civil airports. Look at the threshold definition and runway intersection problems. Take each one of those runways at each end as an instrument approach and see what voids you have!"

J. D. Smith: *"I can think of a very good location into which the airlines operated for years without any difficulty. In fact, I think all of us are better pilots for it. I'm thinking specifically of the old Allegheny County Airport at Pittsburgh, where we had no runway lights at all. Eventually, after a lot of time and study, we came up with a white line down the runway. But before the smoke abatement program took effect, we used to operate in there by looking straight down. We knew and recognized various things on the ground—a house or a fence post, but if they changed the color of the paint on the house we were lost.*

"I think we're putting the cart before the horse if we worry about runway lighting when we don't even have a good clear-cut, positive means of getting to the end of the runway. I agree that runway intersections are a problem and flush lighting may be the answer, but we should stick with our main theme, approach lighting."

George Clement: "The point I want to make is that no matter how good your approach lighting system is, what good does it do you if, when you come to the threshold, you hit a completely blind void?"

J. D. Smith: *"I have to agree with you. At Pittsburgh, when we had an ILS installed there with left-hand lights, we operated at 200 and ½ with four little 50-watt green bulbs to tell us where the end of the runway was. The important point is not having any confusion about what you see. The recent thinking is putting us in the position of seeing something we can't immediately interpret. It's confusing at a time when you are trying to get on the runway. We're compounding the problem at exactly the wrong time."*

A. L. Lewis: "I agree with Mr. Clement and take issue with you on this. If we do get approach lighting reasonably standardized and we don't carry on the runway lighting with it, we've still got dark holes and we'll probably have them for another 15 years. I think we'd better push both, not one at the expense of the other."

J. D. Smith: *"Don't misunderstand me. I'm not saying we don't need better runway lighting. If we want all-weather operation, we need better approach lighting and better runway lighting. However, approach lighting is what we should concentrate on immediately. I think we're actually farther advanced on runway lighting than we are on approach lighting."*

George Clement: "Doesn't this problem seem accentuated to you, Captain, by the fact that in your Allegheny County days you had an approach of about 120 mph and a touchdown of around 65 mph? And now your approach is about 160 or 140 with about a 90-mph touchdown?"

J. D. Smith: *"No, sir. We flew DC-4's and Constellations into Allegheny until about two years ago."*

George Clement: "You don't think the increased approach and touchdown speeds have accentuated the problem?"

J. D. Smith: *"If you are referring to the over-all problem, there's no doubt about that. Windshield condition, for example, is a big factor. The higher the approach speed, the greater the problem if there's a little moisture on the windshield."*

George Clement: "Then the modern airplane under the same meteorological conditions *is* tending to accentuate the over-all problem."

John Gill: "It does because at higher speeds you have less time to figure things

(*Continued on page* 32)

prankish MOODBEAMS #5

While papa blissfully dreams about Southwest Airmotive ads, mama sneaks in with an April First Hotfoot. For technical-minded readers, prankish mama is Pat Ferguson, 20, 5'6", 125 lbs., black-haired, brown-eyed.

Papa, being a pilot, is used to this kind of carryin'-on, regularly suffering through a torture known as The Olde Promised Delivery Date Hotfoote, applied each time his flying machine gets into the shop for a check or overhaul. Getting the darned thing back out again is even tougher than getting a foot out of a frying Texas boot.

We have this to say to papa: The Southwest Airmotive Aircraft Division now has a plan whereby you WILL get your plane on the Promised Delivery Date. Write our Service Rep for details.

— And we have this to say to mama: Cut that out, now — those boots cost 60 dollars!

Southwest Airmotive COMPANY LOVE FIELD DALLAS

Skyways Round Table

(*Continued from page* 31)

out. Pilots do not want something that requires interpretation. Comprehension and guidance must be instantaneous once he breaks out."

A. L. Lewis: "I'm inclined to agree. It's now a matter of time. You can't think in terms of distance. It's what can the pilot do in the allotted time. The Navy has some of the top psychologists working on this problem of pilot or human interpretation."

J. D. Smith: *"Ernie, I wonder if you'd like to get a few words in here on this time element?"*

Ernest Cutrell: "I'd like to refer again to the Italian pilot coming into Idlewild Airport. That fellow might have been coming in on an ILS approach to Runway 4 with a 40-knot, 180° wind. He probably was doing 125 knots indicated and with 35 knots added to that for ground speed. He saw this blue ribbon monstrosity of slopeline lights coming up and possibly thought it was the runway and had no time to think anything out. You can imagine what happened. He landed in the water thinking he was on the runway. That's an example of just taking one look with no time to figure out what he was supposed to do with those two rows of lights."

J. D. Smith: *"Ernie, do you believe that what is initially sighted, when the eye leaves the cockpit instruments and refocuses on visual aids, is probably the key to whether or not a landing can be made out of an ILS approach?"*

Ernie Cutrell: "Definitely."

J. D. Smith: *"At this point, I'd like to have a quick summary of thoughts from each of you. Will you start it off, Dave?"*

David Little: "I firmly believe there is a practical compromise readily obtainable between the exponents of Configuration A and Configuration B. That is the utilitization of the Dutch Elfaka principle of flush lighting for the 1,000 feet of centerline lighting nearest the threshold of the instrument runway. As regards joint civil-military use of airports, it is my firm belief that an airport which is classed as a major civil airport should be implemented for all-weather civil operations, with the military doing the best it can with whatever results."

George Clement: "The flush light principle, rather than any particular design, appears to be the best thing operationally suited for us. We are working on this and we are moving pretty fast. I certainly am going to give every effort to it. I think everyone will find it looks like the best bet, although we've discussed quite a few 'best bets' in the past."

Art Jenks: "J. D., in reference to our statement about time on approach, I'd like to say this. Going one way on an approach you may have 15 to 18 seconds. With today's minimums and a tail wind, that time narrows down to maybe eight or 10 seconds. Take eight or nine seconds and translate that time in terms of Configuration B—what you get is a second or two of lights and then you're over a hole. That's just about what it amounts to with a DC-7 or DC-6B. The situation is difficult, unless the visibility is such that you can pick up information from other sources. Those are some of the things that should be explored and used as educational material for the pilot group as a whole."

George Clement: "I believe some of you gentlemen are looking at this the wrong way. I don't think the way to solve this is to sell the pilot on the idea of what we have to do. The people we have to sell include the chairman of the House Military Affairs Committee, the chairman of the Armed Services Committee, the chairman of the House Military Appropriations Committee, and the chairman of the Senate Armed Services Appropriations Committee."

J. D. Smith: *"I grant you that all of these people have a lot of control and are in fairly good position to determine whether or not money should be made available. Let's assume we sell all of these illustrious gentlemen and we get the money. What happens? Configuration B is spread all over the country!*

"When something is installed that is to be used at the very critical time in the approach, it has to be acceptable to those who are using it."

Ernest Cutrell: "If the test on flush lights is going to be satisfactory, a lot of thought must be given to the kind of test to be run and over how long a period of time. Rules should be set up for the test so it won't drag on for months and months. If that isn't done, the Knoxville test may be another fiasco like the Arcata tests."

Frank Brady: "There are a couple of factors that have been instrumental in preventing us from having a good approach light program. One has been the lack of agreement on basic configuration. I think now, however, we do have a program that will end up in agreement on configuration. As I see it, we are going to get a flush light fixture that will work and we're going to work until we do get it. We have to have it.

"Another factor is the fact that high intensity approach lights do not give an advantage in lowered operating minimums. The basic minimum in the U.S. is 200 ft and ½ mile, regardless of whether a left-hand neon row is used or a complete high intensity centerline system, plus good runway lights and markings, is available. We know that the high intensity system gives us visibility well above that of neon row but as yet no official recognition has been given this fact. We soon must have official acknowledgement of the fact that a 30,000 cp light can be seen farther through haze, smoke and fog than the 25 cp light that is now being used by the Weather Bureau for measuring meteorological visibilities."

Robert Alpher: "I'm not qualified to comment on Mr. Brady's statement regarding possible lowered operating minima, but it seems to me that it is a problem which industry should take up with our aviation safety people. With regard to what Mr. Cutrell said regarding the test of flush lighting, I am in full agreement. The CAA will welcome any recommendations and ideas industry may have in evaluating that type of lighting."

J. D. Smith: *"Mr. Egan, you seem to have the answer to all of our problems."*

Richard Egan: "I wish that were true. I should like to point out, however, that in Holland we have eight airstrips with flush light installations. In Denmark we have six.

"We can make changes in design quickly to suit your requirements. At Soesterberg, which is not far from Schipol, there are 25 or 30 jets operating. We also have three installations, possibly more, on airstrips which have blind crossings. They put in flush lights and everyone is satisfied with the results. A trip over to look at the Elfaka installations would be helpful."

John Gill: "I believe we are close to agreement on flush lighting in the under-shoot area, and every effort should be made to expedite the Knoxville installation. I also believe every effort should be made to replace slope-line. There are only three left, and these should be replaced by the national standard Configuration A. Thirdly, let's replace the left-hand rows with Configuration A, and fourth, let's move toward two-directional approaches. We're kidding ourselves when we think we can operate with a one-directional approach system. It just isn't in the cards.

"When I speak of the National Standard Configuration 'A,' I'm thinking of the complete standard with sequenced flashed condenser discharge lights as installed at Newark. These flashers are a tremendous aid in early identification of the system, reassurance of alignment and permit use of lower candlepowers in the fixed steady-burning bar lighting for night operation. They may rightly be called the heart of the system.

"One point that Frank Brady brought up is very important, namely, give credit to superior visual aids. Regulations already permit us to take advantage of lowered minimums at places where such approach aids permit it.

"Much hinges on flush lighting, and the sooner we find out about it the better. I think we'll then have the answers to a lot of problems."

George Clement: "The flush lights test shouldn't take over 60 days, and we'll try to make it a little shorter, if we can. There are problems of procurement and finance, however. After all, we don't have a pot out of which we can draw money at any time.

A. L. Lewis: "The Navy is watching with interest the tests on flush-type units, and we have provided wheels and tires and static tests on the distortion end of it. The Bureau of Standards is also watching the tests with respect to the Navy configuration. We do have a centerline and I see no reason why it can't be beefed up. If our pilots want cross bars, we can arrange for them. At Navy training stations, we give consideration to somewhat shorter systems, because our types of aircraft do not require the full 3,000-ft approach lighting systems. However, we are trying to install 3,000 ft systems in order to conform to the national standard length and to make the systems universal. Because of the lack of forward visibility in a number of our aircraft, particularly the Delta type, we feel that we must continue for some time with sideline guidance. There's one reason why we have favored a number of crossbars on the order of the British Calvert system—it gives additional side guidance."

John Gill: "Another point that is not generally appreciated is that the one big bar at 1,000 ft is for the specific purpose of eliminating undershoots. Being the only wide bar, it cannot be mistaken. It is a 'go—no go' gauge, and assists all pilots, particularly those flying Delta wings, because once they flare out they are com-

(*Continued on page* 34)

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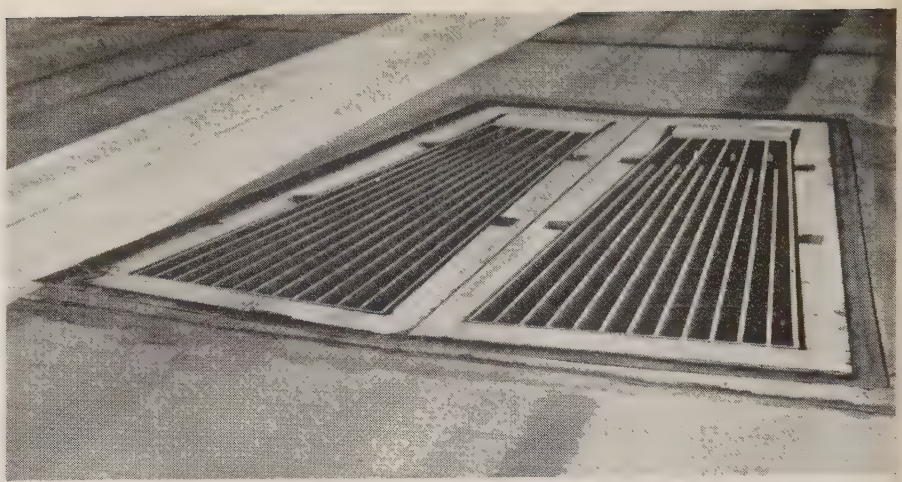

ELFAKA FLUSH LIGHTS—*In this photo close-up details are shown of the paired Elfaka flushlight units forming the centerline coding of the British-developed Calvert configuration*

Skyways Round Table

(*Continued from page* 32)

mitted to a landing. I've spoken to pilots and they say it is extremely important. If they take advantage of the big bar, then undershoots are eliminated or greatly reduced."

A. L. Lewis: "Up to the present time we haven't been confronted with the overrun problem in our Naval operations. We do have a longer 1,000 ft bar, because we need it, and we feel that it is a very necessary part of our system. It is one of the things we'd give up last."

J. D. Smith: *"As is customary, the moderator of this meeting always has the prerogative of having the last word and I'm about to exercise it.*

"In summation, this Round Table has settled on the following facts:

1. "The Knoxville test holds the key to the solution of our problem and will prove that the Dutch Elfaka principle of flush lighting for the 1,000 ft of centerline nearest the instrument-runway threshold is the only answer.

2. "Slopeline lighting should be replaced as quickly as possible.

3. "Configuration A is the choice, and

4. "Consideration should be given to two-directional approaches at terminal airports.

"Gentlemen, on behalf of SKYWAYS, may I thank you for your attendance at this important Round Table discussion. And may I thank SKYWAYS for giving us this opportunity to air our problem publicly. I'm convinced it has helped us to a better understanding of the situation."

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Vickers Viscount

(*Continued from page* 9)

mum climb condition, the system is cut off. Enough water/methanol is carried to restore power under maximum flow conditions for three minutes, approximately represented by a take-off at IAS —20°C to 400 ft, and one overshoot at the same temperature.

To start the engines, the pilot presses a cockpit starter button which operates the electric starter motor, and then opens the high-pressure fuel cock. After starting, the engine speed rises to idling rpm, and the starter motor and igniters automatically switch off. A fuel regulator allows the pilot to adjust the fuel delivery in relation to the outside air temperature. By radioing for the ambient temperature at his destination, the pilot can preset the regulator before arrival at that airport if the temperature differs from that at the take-off point. While this fuel trimming is a manual operation on current *Viscounts*, later models to be delivered to both TCA and Capital will offer automatic fuel trimming.

The aircraft's Rotol propellers were especially designed for the *Dart* engine. The requirements of the direct-coupled turboprop (low starting drag by discing and small residual thrust in flight with the engine throttled) were met by the use of special pitch controls which give pitch ranges from 4° for starting to the fine-pitch stop of 21° for flight, through to 88° for full feathering. In case of engine failure, feathering is automatic.

The props are de-iced by overshoes on the leading edges of the blades. The cyclic type of de-icing system which is employed permits a thin coating of ice to form before being melted off by heating. This reduces current consumption because of the heat-insulating effect of the ice layer and it also prevents run-back of supercooled droplets that might otherwise freeze on the trailing edges.

The cabin of the TCA and Capital aircraft is designed to carry from 40 to 48 passengers depending on seating arrangements. Two washrooms with all facilities are forward of the cabin and a well-equipped galley is located aft of the cabin. Ample cloakroom space also is provided. The *Viscount's* baggage and air freight are carried in three compartments; one in the forward section, one aft of the cabin, and the third, an underfloor hold. All are pressurized to give low-level conditions inside at altitudes up to 30,000 ft. At 15,000 ft,

the *Viscount* cabin pressure is equivalent to sea level; at 23,000 ft, it is equivalent to 4,000 ft above sea level.

Calculations show that the *Viscount* can fly a 500-mile trip with an 11,000-lb payload at an average block speed of 257 mph, at a cost of $510. To break even, therefore, the *Viscount* would have to carry a minimum of 26 or 27 passengers. This does not include possible cargo revenue.

Pilots who have flown the Vickers-Armstrongs *Viscount* report it is unusually light on the controls. In fact, Capt. George Lothian, TCA's superintendent of flight operations, stated that when he first flew the *Viscount* he found it necessary to keep himself in check to keep from banking the aircraft at more than a 20° angle, considered to be the maximum for passenger comfort. He also reported that the lack of vibration in turboprop operations was especially noticeable after flying the *Viscount* and then returning to a conventional aircraft.

In flight, cabin noise is considerably less than that of a reciprocating engine-driven aircraft, although a propeller hum is very noticeable in the forward section of the cabin. The quietest section of the *Viscount* is aft of the wing, and the best seats in the "house" are the last eight, two pairs on opposite sides of the cabin.

The turboprop-liner offers no tendency toward a high-speed stall, as wing loading at full gross weight is 62 lbs—18 lbs less than that of many other aircraft in commercial operation today. As additional insurance, however, a stall warning device has been installed under the left wing. It activates an eccentric wheel on the control stick and gives an unmistakeable shaking to warn of a near-stall condition.

Another noticeable feature, according to pilots, is the position of the ailerons during asymmetric flight at slow speed. In this attitude it is necessary to hold considerable aileron to keep the aircraft flying straight and level. Although the aircraft flies well in this control position, it does take some practice to break the habit of depending on rudder to keep flying straight and level after cutting an engine at low speed.

Most of the aircraft's comparatively simple cockpit checks are accomplished before starting and taxiing. Run-up prior to take-off is held to a minimum because fuel consumption is high during maneuvers on the ground. Instead of loading up, starting and taxiing out to wait for clearance at the end of the runway, the *Viscount* pilot will load up, complete most of the cockpit procedures, and wait for a signal from the tower that his turn is coming up in five minutes; he then taxis directly to take-off position. Immediately before take-off the pilot trims his fuel to conform to the ground temperature conditions.

Taking off with no mag check, the throttles are cut back from 14,500 to 13,600 rpm where they remain until start of climb. Automatic synchronization keeps all engines set to Number three engine, thereby reducing the propeller noise level. Procedures for climbing are: 1) hold 150 knots IAS, and accept the resultant rate of climb; or 2) start at 180 knots IAS, drop 2 knots for each 1,000 feet, and maintain 150 knots for the remainder of

(*Continued on page* 36)

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Vickers Viscount

(*Continued from page* 35)

the climb. The latter method is only slightly less economical under some conditions, but it results in a shorter flight, with cabin floor angles maintained at a better position.

Special trim controls on the *Viscount* assure balanced flight even if the unusual should happen: two engines on one side become inoperative.

Normal cruising altitudes are between 15,000 and 22,000 ft and the assigned or chosen altitude is maintained as long as feasible. Descent is normally carried out by reducing power to 60 lbs torque and an IAS of 190 knots. This results in a rate of descent of 1300 fpm.

A speed of 120 knots is maintained on final approach and reduced to 105 knots at the boundary. Normal landing is accomplished in a fairly flat attitude, the main wheels touching down first with the nose wheel held about six inches above the ground. As soon as the wheels make contact, the propellers flatten into "ground fine-pitch," designed to control the turbine temperatures but giving an additional effect of air braking. With moderate use of brakes the normal landing run of a *Viscount* is from 3600 to 4200 ft. The non-skid brakes used on the first prototype TCA *Viscount* proved successful on ice-bound runways, and on dry runways they reduced the landing run to 1,050 ft, another "plus" for the new airliner.

Passenger interest in the *Viscount* is probably best expressed by the noticeable increase in passenger traffic which British European Airways enjoyed as soon as that line put the turboprop airliner in operation on its routes. On one route alone, BEA registered an 80% increase in the number of passengers it served. Similar increases in passenger traffic are expected by both Trans-Canada and Capital Airlines on this side of the Atlantic, when the *Viscount* goes into scheduled operations.

Specifications

Dimensions:

Wing Span	93 ft 8 in
Fuselage Length	81 ft 2 in
Height	26 ft 9 in
Total Wing Area	963 sq ft
Passenger Cabin	35 ft by 9 ft 5 in

Weights:

Weight Empty	37,700 lbs
Maximum Weight	60,000 lbs
Disposable Load	22,000 lbs
Maximum Payload	11,000 lbs
Maximum Landing Weight	54,000 lbs
Minimum Zero Fuel Weight	49,000 lbs

Tankage:

Fuel	2,342 gal.
Water Methanol	90 gal.
Oil	19 gal.

Power:

Engines (4)	Rolls-Royce MK 506 *Dart*
Propellers	four-bladed Rotol
TO Power (14,500 rpm)	1450 SHP plus 365 lbs thrust
Cruise Power (20,000 ft)	900 SHP plus 60 lbs thrust
Cruise Power (10,000 ft)	1,050 SHP plus 60 lbs thrust

Performance:

Normal Cruise	320 mph
Normal Cruising Altitude	22,000 ft
Fuel Consumption	to 435 gph
Rate of Climb s.l. (at 60,000 lbs)	1,150 fpm
Service Ceiling (at 56,000 lbs)	27,500 ft
Take-off Distance (Max.)	3800 ft
Landing Distance (at 54,000 lbs)	3,000 ft
Range with Max Payload (still air)	1500 s mi
Max Range (still air)	2100 s mi

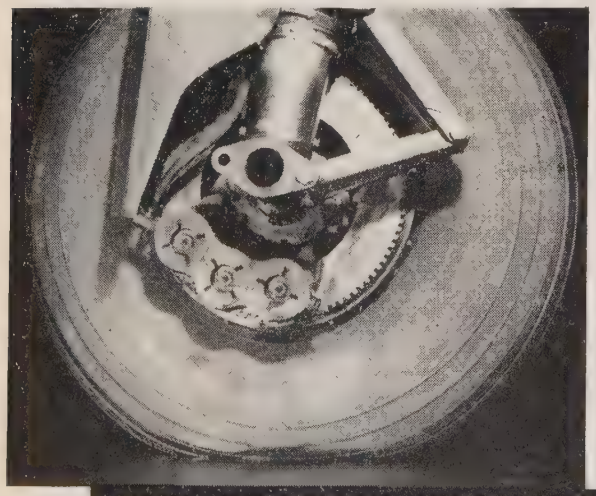
Engineering in Overhaul

(*Continued from page* 15

authority in allocating the expended man-hours to the best interest of the time-keeping operation, over-ruling the production-line station supervisor. Supervisory personnel sometimes want to change the man-hour expenditure distribution for their own convenience. The production engineer must be alert to this at all times, particularly when the man-hours budgeted to a certain production station are not in accord with the estimate, allowing for a reasonable amount of discrepancy.

Another phase of work control along the production line is in the detail production-planning orders. These detailed orders list the operations and the proper sequence in which the overhaul work is to be accomplished. The inspector stamps each order with his approval stamp as each work operation is done in conformity with the orders. It is assumed that the quality of the workmanship will be in accord with the Civil Air Regulations. When rework is necessary as a result of errors or poor quality workmanship causing an inspection rejection, the production engineer should issue directions to have special orders written to cover the man-hours expended by this corrective action.

In the other phase of the overhaul operation, the production engineer is concerned with the performance of the overhaul shop. Only by setting up control by means of production-planning orders is it possible to determine the efficiency of the shop. A method similar to that of cost control and timekeeping will suffice for the production line. These orders provide information regarding the work to be accomplished on each part and provide for an inspection approval stamp after the part has been declared serviceable through testing to the required performance. Parts which are removed as a result of an inspection discrepancy can be detected and the work of reconditioning them segregated if the production engineer decrees that no work of this kind will be performed unless a formal order is obtained from the production planning section of Production Control. This can be accomplished with the cooperation of the Inspection Department which will not inspect any part removed as a result of an inspection discrepancy *unless* accompanied by an authentic order directing that part to be overhauled. Overhauled



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parts can only be declared serviceable for installation after the inspector attaches a yellow tag and affixes his inspection stamp. Thus it is possible to not only control the quality of overhauled parts being reinstalled on the airplane but also to make it difficult to conceal errors or omissions and impair the quality of workmanship.

Schedule of Completion: The production engineer gauges the entire operation of an overhaul facility by the master schedule of anticipated deliveries. The final form of the schedule is prepared from data obtained on previous contracts, the customer's specifications of work to be accomplished, the work load and its inherent effect on the production facilities, the availability of serviceable or procured parts, the work load that the overhaul shops can assume, and the possible expansion of work operations to meet a specific schedule of completion.

Similarly, the master schedule must have flexibility and be prepared so that revisions of the anticipated delivery date can be made without disrupting the general pattern of overhaul operations. Where workload changes occur as a result of the condition of the airplanes on arrival, new schedules must be issued, and the inherent effect on the parts availability and procurement carefully coordinated with Materiel Control functions.

Material Control Functions: Putting it simply, the fundamental objective of Materiel Control is to have a supply of parts, assemblies, and material available and to maintain an accurate accountability of these. In this respect, the production engineer must plan for Materiel Control by giving that department the flow charts of how all parts are to be removed from the airplane, how they will be repaired, how accounted for, how these will be stocked, and how they will be issued to the production line. The production engineer should make constant checks to be certain no unforeseen shortages arise.

Another way for the production engineer to be of assistance is to periodically review the acquisition of parts or raw material to be certain they are flowing into the facility at a rate sufficient to offset consumption by the production line. A shortage of material means waste of direct and indirect labor if the work schedule is interrupted. At the same time, delivery schedules must be controlled so as not to create a storage problem when the stockroom facilities are limited.

Inspection Quality Control: Specifications which govern the quality of workmanship are usually contained in an inspection manual, which serves as a guide to assure quality of workmanship in conformity with the CAR requirements.

The breakdown of each production or overhaul operation is an aid to the maintenance of quality in workmanship because inspectors must be present when functional parts are being tested. Where the airframe is concerned, serviceable parts are reinstalled in the presence of inspectors, and the quality of the installational work is either approved or rejected. Functional operational tests are also performed in their presence. Final inspection is performed on the entire airplane prior to delivery to the flight line for the servicing and run-up checks, etc.

Quality control is a joint function of the production engineer, inspection personnel, and engineering personnel. Usually, because of his unique position, the production engineer functions as the coordinator for the entire operation. Quality control is important not only in the interest of flight safety but also in keeping down the cost of the overhaul operation, consistent with good workmanship. In fact, when sufficient man-hours have been allowed in the labor expenditure budget, failure to comply with a pre-planned schedule can nearly always be traced to ineffective quality control.

Shop Process Manuals: Normally, all aircraft mechanical personnel are conscious of their personal responsibility to do good work. Sometimes, however, because of inexperience, certain work may be performed in an incorrect manner. In order to assist the mechanical personnel, the production engineer should organize a shop process manual which contains detailed instructions on how certain of the shop processes are performed, lists specifications of materials either direct or indirect, provides flow charts on how the work operations are performed in sequence, shows organization charts to depict lines of administrative responsibility, copies of administrative directives and policies in relation to shop personnel and outlines the purpose of timekeeping operations. If the engineer compiles a manual such as this, it constitutes a written policy which may be used as a basis in disputes over shop operations.

(*Continued on page* 40)

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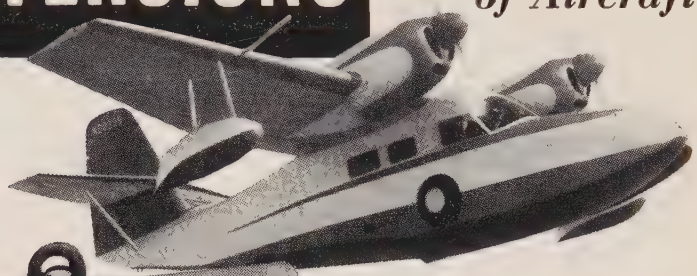

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Engineering in Overhaul

(*Continued from page 37*)

Production Control: Regardless of any master schedule, certain deviations will occur in any air-transport overhaul program. These may not always be intentional but the fact remains that the production engineer must have a Production Control organization working under his jurisdiction which is effective in performing follow-up functions. For example, nearly all daily progress reports show some kind of deviation from the pre-planned schedule, and large deviations are easily traceable and corrected accordingly. However, it is the minor deviations that, when accumulated, may impose delay in the actual delivery of an overhauled airplane. In this respect, effective production control operations prevent minor delays from disrupting the schedule. Thus, production control action arrests delays on the minor causes whereas the production engineer arrests the delays and presents effective corrective action on major causes for delay.

When the actual overhaul work starts—and this should not be undertaken until all production planning, scheduling, manpower, and material control functions have been completed for the initial phase of the work—an effective follow-up system must be employed to forestall carelessness in complying with the working schedule. In order to attain this objective and thus prevent wasted man-hour effort, the follow-up system should have means available so that repetitive checks and man-hour analysis data are instantly available. Usually, the analytical phase of this statistical follow-up is done by means of graphical analysis of the past performance or a mechanical visual system such as the Productrol. Discrepancies in compliance with the schedule can thus be brought to the attention of management or predicted in advance with corrective action instigated.

Overhead Cost Control: The difference between profit and loss in the operation of a production maintenance facility lies in the effectiveness of the method of cost control. In the past, among the contributing factors leading to the demise of post-war air-transport maintenance facilities, was the failure to properly assess and distribute the overhead costs. In some instances, excess costs were assessed against phases of the operation which should have had a minimum and vice-versa.

The key to accurate cost control is an effective system of production planning paperwork. This system should preferably be of the "DITTO" system of multiple copies. The flow of these orders and the abstraction of cost data is essential to gauging the operational cost for mainte-

nance or fabrication operations.

Another factor of cost control is the allocation of the stores requisitions for disbursed materials against specific projects. Every time a material requisition is processed, the accounting charge against which the material has been drawn should be entered upon the requisition. This facilitates the costing and segregation of charges.

Frequently, for want of better accounting cost data, air-transport facilities have arbitrarily established an overhead cost factor of 100% against direct labor expenditure. For some unknown reason, this seems to be a magical figure which is not always correct and may vary considerably with various kinds of maintenance operations. In some instances it has been found that costs to perform identical operations on the same kind of airplane in production operations have varied as much as 30% from the established norm of 100%. On a fixed price contract, this would be disastrous.

The inability to properly assess shop operational costs is chiefly caused by an inefficient timekeeping system. Timekeeping is too important in relation to the company welfare to be kept haphazardly by mechanical personnel. Specialized timekeepers must be assigned, not more than 75 personnel to one timekeeper. The cost of the timekeepers must be accepted as part of the indirect labor cost. Timekeepers effectively employed prevent the misallocation of man-hours, thus keeping the overhead costs proportionate. In order to obtain accurate timekeeping information, it should be the joint responsibility of production engineering and the cost accountant to coordinate their efforts in order to get accurate timekeeping information. If honest and unbiased results are to be obtained for the good of the company, their work should not be hampered by administrative pettiness on the part of mechanical supervisors. Accurate results and the true distribution of overhead costs are essential in order to exist in a competitive business.

Availability of Reports: Production and cost reports should be made available to supervisory personnel in order that they may judge for themselves the results of their performance. These reports should be issued periodically in order to prevent them from becoming factual case history, too late to be of importance for corrective action or constructive criticism.

These reports may be presented graphically or statistically in order that they may be effective. The variation between the actual cost and estimated cost should be shown clearly as well as the actual expended man-hours and the planned man-hour expenditure. Regardless of the method used to illustrate the results, the reports must be timely, simple to understand, and unbiased. Detailed reports are nearly worthless so do not use them. Sometimes ratio graphs, plotted logarithmically on the vertical scale and arithmetically on the horizontal scale, show true comparisons effectively.

Effective production engineering is that which reduces the expenditure of needless man-hours commensurate with the lowest cost of operation consistent with quality. To work effectively, the production engineer should report directly to the Works Manager and be a member of his staff in order to prevent departmental friction from hin-

(*Continued on page* 42)

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Engineering in Overhaul

(*Continued from page* 41)

dering his operations. If this is not done, the production engineer cannot function, effective shop operation will not be possible, nor is the reflection of the true costs attained in the annual profit and loss statement. And only by making reasonable profits on the work is it possible to continue in business. It is strange, but in air-transport maintenance operations, many of the rank and file as well as supervisory personnel overlook that fundamental. +T+

Airline Cockpit Concept

(*Continued from page* 11)

to get ground speed. Integrating ground speed for the time enroute will then tell him how far he has gone and when this distance is plotted on some suitable chart or how-goes-it record, his original question will be finally answered. Some pilots are capable of doing this calculation quite rapidly and accurately and others make fatal errors. It is only necessary to build a computer which will do this calculation for the pilot and tell him continuously where he is at any given moment.

Actually, in order to get answers, there is no need to increase the over-all weight of the plane if the equipment is designed as an integrated system. All instrumentation consists fundamentally of a sensor, an amplifier, a computer, and a receiver or instrument. With very few exceptions, almost every system in the airplane has its own sensor, its own computer, its own amplifier, and in most cases even its own power source. In the computers and amplifiers there are some circuits which are almost identical in their function although not in their design. If all these common circuits were combined and operated on a time-sharing basis, the over-all weight could be reduced considerably and the units could be much more reliable. This can only be done, however, if the *entire* system is redesigned. Simplification cannot be achieved if compromises are made to take care of the deficiencies of a part of the system. Once the requirements have been established for the over-all control and instrument system, and an analysis has been made of the state of the art, the design of the equipments will become evident, and without any great degree of compromise.

Another attitude which must be changed if cockpits are to become more simplified is the old idea that 'if it was good enough for grandpa, it is good enough for me.' In the first place grandpa wasn't flying as often, as high, or as fast as we are today. There are two types of people who tend to have this attitude: the pilot who is reluctant to any change, and the manufacturer or engineer who doesn't want to take the time and effort to redesign. Incidentally, these two types are always the strongest advocates of standardization, and indirectly they are actually sponsoring stagnation. This is not meant in any way to suggest the termination of standardization but rather to point out that too much standardization at the wrong time can retard advancement. Equipments have been severely hampered by certain so-called standard items such as electrical terminals, cable, couplings, etc., simply because these fittings were bulky, heavy, and designed from obsolete specifications. The utmost effort is made to eliminate every ounce of weight that can be spared in the prime piece of equipment and then, because of the rules of standardization, the entire development is burdened by a mass of heavy cables and fittings which were designed for a completely different set of gear. If the piece of equipment is to be redesigned, then the associated parts should be redesigned also. Again, a very definite set of requirements must be established before the equipment design is started. If the requirements call for a different set of associated parts, then standardization must be abandoned for the sake of making the equipment adequate for its task. Actually, when any system becomes completely adequate, standardization will come about automatically.

In summary:

1. Pilots should stop accepting and start *demanding* equipment for their cockpits. In doing this, however, they must overcome their reluctance to change.

2. Pilots must begin to state their requirements in fundamental terms rather than in terms of modifications to existing equipments. They should stop trying to design equipment and stick to their task of stating in precise terms the kind of information they require to acomplish their main job of operating the aircraft.

3. Airlines should establish a dual program. One to take care of the immediate problems and a companion program to look into the future and to seek ideal cockpits.

4. The program must be conducted by a team of pilots, human engineers, engineering physicists, and engineers. The pilots state the data they need, the human engineers establish how the pilots should receive the data, the engineering physicists determine the technical requirements for the controls and display, and the engineers implement the technical requirements. The final conclusions will be made when the pilots determine by test whether the information requirements have been met.

5. The cockpit, pilot, instruments, controls, and associated equipment must be treated as a completely integrated system, each element affecting the design of all other elements.

6. Each piece of equipment regardless of how small a part it plays must be designed on the basis of fundamental requirements rather than on personal opinion or the fact that it is a 'standard' item.

If this approach is followed, there is no reason to doubt that an airplane cockpit of the future can be developed which will permit truly all-weather operation because the pilot will be performing at peak efficiency with totally reliable equipment with a minimum of training, and the aircraft will be carrying a maximum payload.

An airline can only be as efficient as the pilots who fly its planes.

Pilots can only be as efficient as their equipment will permit. +T+

This paper was presented to ALPA at its Safety Forum in Chicago. Opinions or conclusions contained in this report are those of the author. They are not to be construed as necessarily reflecting the view or possessing the endorsement of the Navy Department.

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(4-55)

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Cruise Control–D18S

(*Continued from page* 14)

acteristic and the excellent rate of climb, as they affect the operating picture, were shown in the discussion on altitude choice.

Approximate critical altitudes are shown by the "breaks" in the sloping lines, plotted thereafter by dash lines. Operation at power combinations and altitudes falling along the solid lines will be at partial throttle, and at full throttle above the critical altitudes. BMEP in the full-throttle area of operation will be necessarily less than 120 psi, due to maintaining desired BHP by increased RPM.

For those who encounter difficulty in obtaining the charted speeds, the following suggestions are offered:

(1) Check all flap and control surface rigging.
(2) Check landing gear door droop.
(3) Have airspeed instrument error determined.
(4) Use 3 mph installation calibration on the airspeed.
(5) Is CG within limits?

If the above does not remedy the situation, the difficulty probably lies in increased external drag through addition of dual pitot heads and numerous antennas. Familiarity with a particular airplane will determine any possible corrections you wish to make. Gross weight reduction results in some airspeed gain, but is not made an accountable factor.

Effect of Wind and Power on Range: *Figure 4* was designed as a quick aid to preliminary flight planning. The chart is not a maximum-range chart because it does not account for altitude and gross weight reduction. For practical purposes, at the altitude specified, it may be used as such. The scale permits range answers of sufficient accuracy to justify making out a flight plan, saving some trial-and-error calculations. Plots must fall to the left of the wind component line in order to be feasible. It should be noted that the chart is drawn for 286 gallons of fuel, with :45 reserve. An example of chart use would be a proposed flight of 900 miles against a −40 wind component; the chart indicating that the flight can be made at 60% or lesser powers, but not at 65% power.

The chart may also be used to give power for minimum flight time over any distance, the power answer being read horizontally to the left of the intersection of trip mileage and wind component.

The dash line entitled "power for maximum range considering wind" is plotted for a chart entry of wind component alone, not mileage or power. That power is read to the left of the intersection of the dashed line and the appropriate wind component; range in miles is read vertically below that intersection.

The chart was extended down to 45% power, not for any contemplated practical use but in order to show the point at which the gain in range changes to a loss in range with reduction in power. Theoretical maximum range will be attained at even less power for conditions of still air or favorable wind components. Curvature of the lines indicates the rate of gain in range with power reduction. It will be noted that the rate of gain is appreciable down to 55%, diminishing thereafter dependent on the wind.

This suggests to me the use of this power, or possibly 50% under some conditions, as a practical long-range power setting. One sees more and more of these aircraft through the islands of the Caribbean, in Central and South America. Should the occasion for such flights arise, there is no reason why they cannot be made with safety. The airplane is well equipped with the necessary performance.

Horsepower Calculator and Temperature Correction: All the previous discussions of power, BMEP, and consumption were predicated on a means of accurately determining those items. Pratt & Whitney power calculator model PC-2 is recommended. Additional RPM and Hg lines may be extrapolated below 1800 RPM in order to obtain the settings suggested.

Pratt & Whitney recommends climb, cruise, and let-down with sufficient carburetor heat to maintain a temperature *below* the carburetor of 90°F as an aid to mixture distribution and to prevent ice formation. This cannot be done with any degree of accuracy on the DI8S because the temperature indication is taken from *above* the carburetor, and the temperature drop across the carburetor is not a constant value, but varies between 35°F and 50°F and sometimes as high as 70°F.

Their alternative recommendation, and one which can be employed on the DI8S, is to maintain temperatures *above* the carburetor *at least* above freezing for the flight conditions specified. A temperature of 38°F would appear to meet this requirement with due allowance for possible instrument error.

Application of carburetor heat will cause a slight reduction in power output. Additional manifold pressure must then be applied to correct for this temperature variance from standard air. In most cases, the problem is solved, practically speaking, by the addition of ½" Hg to regain this lost power. This additional applied Hg will slightly lower the critical altitude for each BHP-RPM combination.

Mixture: Mr. MacClain of Pratt & Whitney volunteered the information that the R985 was tuned up to run at .072 on the engine exhaust analyzer up to 66% power, best power mixture (for detonation reasons) from 65% to 75% power, and considerably richer than the best power for powers above 75%. Fuel flows listed in the paragraph on consumption were calculated at representative mixture settings in order to adhere to this recommended procedure. The maintenance of the exhaust analyzer is important and the ball of steel wool should be replaced only with the type of wool for that purpose. In no case should the engine be run at a mixture setting inducing roughness.

Climb Power: The engine manufacturer suggests climb powers not to exceed 75% at 120 psi. The horsepower calculator shows this to be 29" Hg, 2,000 RPM at sea level, reduced above that altitude at the rate of 1" Hg every 4,000 feet. Engines may be leaned on climb to .085 provided temperatures behave. This will be possible in winter but not likely in summer.

Level Off and Descent: After the airplane has reached cruising altitude, the engine should be given a chance to cool, preferably below the final cruise temperatures, before leaning operations are begun. This permits the impeller area, for which there is no temperature indication, also to cool, thus lowering the charge temperature and detonation possibilities.

Descent should be considered as a cruising condition. Where reduced power is necessary to avoid airspeed build-up in rough air, the author suggests that RPM be reduced along with manifold pressure to 1500 RPM to avoid exceeding the limits of the propeller load curve. This does not mean that operation slightly ouside this limit will produce any serious consequences, but rather that the proper RPM-power combination will result in a lower wear factor. The importance of this varies depending on how far outside the limit one is operating, and according to the time spent in making let-downs.

Improved combustion at 1500 RPM on a reduced power descent improves engine temperatures during cold weather. Less plug fouling will also be encountered.

The DI8S has long been a popular business plane and it will continue to be. As with all aircraft, its efficiency in operation depends largely on the proficiency of the pilot.

Lear L-10

(*Continued from page* 19)

into the roll channel rather than the yaw channel of the amplifier. Under certain dynamic conditions, portions of the heading signal are also fed into the rudder. Heading correction is then made through banking of the aircraft.

A rate gyro oriented in yaw and a side-slip detector, which supply the required stabilization signals to the rudder positioning loop, make possible perfect turn coordination.

Maneuvers which exceed safe structural loads for aircraft are prevented by safety provisions built into the L-10. Other safety features include manual over-ride of the autopilot by the pilot, and automatic or manual disengagement of the autopilot in the event of malfunction.

Although its performance is improved, the L-10 is lighter than the F-5.

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